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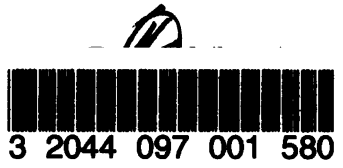


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KEY TO

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COMPLETE ARITHMETIC

FOR TEACHERS

By E. E. WHITE, A. M., LL.D.



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PREFACE.

THIS Key contains solutions to all the problems, oral and written, in

WHITE'S NEW COMPLETE ARITHMETIC,

Excepting the inductive oral problems, and those purely drill problems which present no difficulty to those who are familiar with the processes involved.

Most of the solutions of the written problems are given in the equation form, since this not only requires less space than any other, but it also permits the giving of all needed explanations in connection with the solutions. It is assumed that all teachers can perform the numerical operations indicated.

CINCINNATI, O., April 5, 1884.

N. B.—Any one who may discover an error in this edition, will confer a favor on the author by calling his attention to it.

KEY TO WHITE'S

NEW COMPLETE ARITHMETIC.

SOLUTIONS OF PROBLEMS.

Page 45.

Prob. 38. L. C. M. of 10, 12, and 15 = 60, no. of min. each will walk;

60 min. ÷ 10 min. = 6, no. of miles A will walk;
60 min. ÷ 12 min. = 5, no. of miles B will walk;
60 min. ÷ 15 min. = 4, no. of miles C will walk.

FRACTIONS.

Page 52.

48. $\frac{9+3}{12+3} = \frac{3}{4}$. Since $\frac{1}{4}$ is $\frac{3}{12}$, $\frac{3}{4}$ is 3 times $\frac{3}{12}$, which is $\frac{9}{12}$, and hence the resulting fraction $\frac{3}{4}$ equals $\frac{9}{12}$.

49. If, for example, both terms of $\frac{12}{15}$ be divided by 3, the resulting fraction is $\frac{4}{5}$. The size or value of the fractional part in $\frac{4}{5}$ is 3 times as great as in $\frac{12}{15}$, while the number of parts taken in $\frac{4}{5}$ is only one third of the number of parts taken in $\frac{12}{15}$; and hence $\frac{4}{5} = \frac{12}{15}$.

In like manner, it may be shown that the division of both terms of any fraction by the same integer divides the number of parts taken by the integer, and, at the same time, increases the size or value of each part taken as many times as there are units in the integer; and hence the value of the resulting fraction equals the value of the given fraction.

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94. $\frac{2\times4}{3\times4} = \frac{8}{12}$. Since $\frac{1}{3}$ equals $\frac{4}{12}$, $\frac{2}{3}$ equals 2 times $\frac{4}{12}$, which is $\frac{8}{12}$, and since the resulting fraction $\frac{8}{12}$ equals $\frac{2}{3}$, the value of the fraction is not changed.

95. If both terms of the fraction $\frac{3}{4}$ be multiplied by 3, the resulting fraction will be $\frac{9}{12}$. The number of parts taken in $\frac{9}{12}$ is 3 times as many as the number of parts taken in $\frac{3}{4}$, but the size or value of the part taken in $\frac{9}{12}$ is only one third of the size or value of the part in $\frac{3}{4}$, and hence $\frac{9}{12} = \frac{3}{4}$.

In like manner, it may be shown that the multiplying of both terms of any fraction by an integer multiplies the number of parts taken by the integer and divides the size of the parts taken by the same number, and hence the value of the resulting fraction equals the value of the given fraction.

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10. Take, for example, $\frac{2}{9}$, $\frac{5}{9}$, and $\frac{4}{9}$. The fractional unit in each of these fractions is *one ninth*, and, since $\frac{2}{9}$, $\frac{5}{9}$, and $\frac{4}{9}$ are composed of the same fractional unit, they are like numbers, and hence may be added. The sum of the numerators (9) is the number of this common unit (ninth) in all of the fractions taken together.

In like manner, it may be shown that all fractions which have a common denominator, are composed of the same fractional unit, and hence are like numbers and can be added.

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11. The fraction $\frac{2}{3}$ can not be subtracted from $\frac{3}{4}$ without first reducing them to equivalent fractions with a common denominator, because the fractions $\frac{2}{3}$ and $\frac{3}{4}$ are not composed of a common unit, and hence are not like numbers.

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50. $16\frac{3}{4}$ gal. $+ 21\frac{3}{8}$ gal. $= 38\frac{1}{8}$ gal., quantity sold;
$45\frac{1}{2}$ gal. $- 38\frac{1}{8}$ gal. $= 7\frac{3}{8}$ gal., quantity unsold.

51. $\frac{8}{10} + \frac{5}{12} = \frac{18}{60} + \frac{25}{60} = \frac{43}{60}$, part to wife and children;
$\frac{60}{60} - \frac{43}{60} = \frac{17}{60}$, part to college.

52. $\frac{2}{5}$ of $\frac{2}{3} = \frac{4}{15}$, part of factory sold;
$\frac{2}{3} - \frac{4}{15} = \frac{2}{5}$, part still owned.

53. $\frac{2}{9} + \frac{2}{7} = \frac{32}{63}$, part in mud and water;
$\frac{63}{63} - \frac{32}{63} = \frac{31}{63}$, part in air.

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9. The multiplying of the numerator of $\frac{4}{15}$ by 3 multiplies the number of parts taken by 3, while the size or value of the parts is not changed, and hence the value of the fraction is multiplied by 3. $\frac{4\times3}{15} = \frac{4}{15} \times 3$.

10. The dividing of the denominator of $\frac{4}{15}$ by 3 increases the size or value of each part taken 3 times, while the number of parts taken is not changed, and hence the value of the fraction is multiplied by 3. $\frac{4}{15\div3} = \frac{4}{15} \times 3$.

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36. $5 \times \frac{3}{4} = \frac{15}{4}$, and $\frac{3}{4}$ of $5 = \frac{15}{4}$; hence $5 \times \frac{3}{4} = \frac{3}{4}$ of 5.

In like manner, it may be shown that the product of an integer by any fraction equals the fraction of the integer.

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73. $\frac{3}{4} \times \frac{5}{6} = \frac{3\times5}{4\times6} = \frac{5}{8}$; $\frac{5}{6}$ of $\frac{3}{4} = \frac{5\times3}{6\times4} = \frac{5}{8}$; hence $\frac{3}{4} \times \frac{5}{6} = \frac{5}{6}$ of $\frac{3}{4}$.

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101. $\$245 \times \frac{7}{8} = \$214\frac{3}{8}$.

102. $\$13250 \times \frac{7}{12} = \$7729\frac{1}{6}$.

NOTE.—The ship was sold for \$13250, and the man's share is $\frac{7}{12}$ of \$13250.

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10. The dividing of the numerator of $\frac{8}{9}$ by 4 divides the number of parts taken by 4, while the size or value of the parts is not changed, and hence the fraction $\frac{8}{9}$ is divided by 4. $\frac{8}{9} \div 4 = \frac{8\div4}{9}$.

11. The multiplying of the denominator of $\frac{8}{9}$ by 3, divides the size or value of the parts by 3, while the number of parts taken is not changed, and hence the fraction $\frac{8}{9}$ is divided by 3. $\frac{8}{9} \div 3 = \frac{8}{9\times3}$.

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37. $12 \div \frac{1}{6} = 12 \times 6$; $12 \div \frac{5}{6} = \frac{12\times6}{5} = 12 \times \frac{6}{5}$; hence $12 \div \frac{5}{6} = 12 \times \frac{6}{5}$.

38. $10 \div \frac{1}{8} = 10 \times 8$; $10 \div \frac{3}{8} = \frac{10\times8}{3} = 10 \times \frac{8}{3}$; hence $10 \div \frac{3}{8} = 10 \times \frac{8}{3}$.

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60. Take, for example, $\frac{2}{5}$ for a dividend and $\frac{3}{4}$ for a divisor; $\frac{2}{5} \div \frac{3}{4} = \frac{2\times4}{20} \div \frac{5\times3}{20} = \frac{2\times4}{5\times3} = \frac{2}{5} \times \frac{4}{3}$.

In like manner, it may be shown that the quotient of any two fractions equals the dividend multiplied by *the reciprocal* of the divisor.

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9. $\frac{\frac{5}{6} \text{ of } \frac{6}{7}}{\frac{2}{3} \text{ of } \frac{3}{8}} = \frac{5}{6} \text{ of } \frac{6}{7} \div \frac{2}{3} \text{ of } \frac{3}{8}$;

$\frac{5}{6} \text{ of } \frac{6}{7} = \frac{5}{7}$; $\frac{2}{3} \text{ of } \frac{3}{8} = \frac{1}{4}$; $\frac{5}{7} \div \frac{1}{4} = \frac{20}{7} = 2\frac{6}{7}$.

10. $\frac{\frac{2}{7} \text{ of } 2\frac{1}{3}}{5\frac{1}{2}} = \frac{2}{7} \text{ of } 2\frac{1}{3} \div 5\frac{1}{2} = \frac{2}{3} \div \frac{11}{2} = \frac{4}{33}$.

11. $\frac{\frac{3}{8} \text{ of } \frac{4}{9}}{\frac{5}{12}} = \frac{3}{8} \text{ of } \frac{4}{9} \div \frac{5}{12} = \frac{1}{6} \div \frac{5}{12} = \frac{12}{30} = \frac{2}{5}$.

12. $\frac{\frac{6}{11}}{\frac{4}{7} \text{ of } \frac{14}{33}} = \frac{6}{11} \div \frac{4}{7} \text{ of } \frac{14}{33} = \frac{6}{11} \div \frac{8}{33} = \frac{9}{4} = 2\frac{1}{4}$.

13. $\frac{\frac{3}{8} + \frac{3}{10}}{\frac{3}{8} - \frac{3}{10}} = (\frac{3}{8} + \frac{3}{10}) \div (\frac{3}{8} - \frac{3}{10})$;

$\frac{3}{8} + \frac{3}{10} = \frac{27}{40}$; $\frac{3}{8} - \frac{3}{10} = \frac{3}{40}$; $\frac{27}{40} \div \frac{3}{40} = 9$.

14. $\frac{\frac{5}{7} - \frac{1}{3}}{\frac{3}{4} + \frac{8}{9}} = (\frac{5}{7} - \frac{1}{3}) \div (\frac{3}{4} + \frac{8}{9})$;

$\frac{5}{7} - \frac{1}{3} = \frac{8}{21}$; $\frac{3}{4} + \frac{8}{9} = \frac{59}{36}$; $\frac{8}{21} \div \frac{59}{36} = \frac{96}{413}$.

15. $\frac{\frac{7}{8}}{\frac{3}{4}} \times \frac{\frac{5}{9}}{\frac{1}{6}} = (\frac{7}{8} \div \frac{3}{4}) \times (\frac{5}{9} \div \frac{1}{6})$;

$\frac{7}{8} \div \frac{3}{4} = \frac{7}{6}$; $\frac{5}{9} \div \frac{1}{6} = \frac{10}{3}$; $\frac{7}{6} \times \frac{10}{3} = 3\frac{8}{9}$.

16. $\frac{\frac{2}{9}}{\frac{3}{4}} \div \frac{\frac{3}{4}}{\frac{5}{9}} = (\frac{2}{9} \div \frac{3}{4}) \div (\frac{3}{4} \div \frac{5}{9})$;

$\frac{2}{9} \div \frac{3}{4} = \frac{8}{27}$; $\frac{3}{4} \div \frac{5}{9} = \frac{27}{20}$; $\frac{8}{27} \div \frac{27}{20} = \frac{160}{729}$.

17. 15 A. $\div \frac{5}{8}$ A. $= 24$, number of lots.

18. $6\frac{2}{3} \div 21 = \frac{20}{3} \div 21 = \frac{20}{63}$, the other number.

19. $26\frac{2}{3} \div \frac{3}{5} = \frac{80}{3} \div \frac{3}{5} = 44\frac{4}{9}$.

20. $2\frac{1}{3}$ bbl. $\div \frac{4}{9}$ bbl. $= \frac{7}{3} \div \frac{4}{9} = \frac{63}{12} = 5\frac{1}{4}$, no. of months.

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21. $\$6\frac{1}{2} \div \$\frac{5}{8} = \frac{13}{2} \div \frac{5}{8} = \frac{104}{10} = 10\frac{2}{5}$, no. of bushels.

22. $\$17\frac{1}{3} \div 13 = \$1\frac{1}{3}$, cost per yard;

$\$48\frac{4}{5} \div \$1\frac{1}{3} = \frac{244}{5} \div \frac{4}{3} = \frac{732}{20} = 36\frac{3}{5}$, no. of yards.

23. $20\frac{1}{4}$ mi. $\div 3\frac{3}{10}$ mi. $= \frac{81}{4} \div \frac{33}{10} = \frac{810}{132} = 6\frac{3}{22}$, no. of hours.

24. $\$841\frac{2}{3} \div \$33\frac{1}{3} = \frac{2525}{3} \div \frac{100}{3} = 25\frac{1}{4}$, no. of acres.

Or, $\$841\frac{2}{3} \div \$33\frac{1}{3} = \$841\frac{2}{3} \times 3 \div 100 = 25\frac{1}{4}$, no. of acres.

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5. The sum of $\frac{2}{5}$, $\frac{1}{3}$, and $\frac{1}{6}$ is $\frac{27}{30}$; and $\frac{30}{30}$ less $\frac{27}{30}$ is $\frac{3}{30}$, or $\frac{1}{10}$, the part of price paid the third year.

6. $\frac{1}{7}$ of 42 years is 6 years, and $\frac{2}{7}$ of 42 years is 2 times 6 years, or 12 years, the age of the son.

7. If he sold the cow for $\frac{5}{6}$ of the cost, he lost $\frac{1}{6}$ of the cost; $\frac{1}{6}$ of $\$33\frac{1}{3}$ is $\$5\frac{5}{9}$, the sum lost.

8. If $\frac{5}{6}$ of a yard cost $\$8\frac{1}{3}$, $\frac{1}{6}$ of a yard cost $\frac{1}{5}$ of $\$8\frac{1}{3}$, or $\frac{1}{5}$ of $\$\frac{25}{3}$, which is $\$\frac{5}{3}$, and $\frac{3}{6}$ of a yard cost 3 times $\$\frac{5}{3}$, which is $\$\frac{15}{3}$, or $5.

9. If Mary's age is $\frac{3}{4}$ of Jane's, it is $\frac{3}{4}$ of $16\frac{2}{3}$ years, which is $\frac{1}{4}$ of 50 years, or $12\frac{1}{2}$ years: Mary's age is $12\frac{1}{2}$ years.

10. If the man sold $\frac{2}{5}$ of his share, he sold $\frac{2}{5}$ of $\frac{5}{8}$ of the mill, which is $\frac{10}{40}$, or $\frac{5}{8}$, of the mill, and hence he had left the difference between $\frac{5}{8}$ and $\frac{5}{8}$ of the mill; $\frac{5}{8} - \frac{5}{8} = \frac{30}{36} - \frac{20}{36} = \frac{10}{36}$, or $\frac{5}{18}$, the part of the mill he had left.

11. If Charles gave his sister $\frac{3}{8}$ of a pound, he had left the difference between $\frac{3}{4}$ and $\frac{3}{8}$ of a pound, which is $\frac{3}{8}$ of a pound; if he gave a playmate $\frac{2}{3}$ of what was left, he gave him $\frac{2}{3}$ of $\frac{3}{8}$ of a pound, which is $\frac{2}{8}$, or $\frac{1}{4}$, of a pound, and Charles had then left the difference between $\frac{3}{8}$ and $\frac{1}{4}$ of a pound, which is $\frac{1}{8}$ of a pound.

12. If 35 years are $\frac{5}{7}$ of her husband's age, $\frac{1}{7}$ of it is $\frac{1}{5}$ of 35 years, which is 7 years, and $\frac{7}{7}$ is 7 times 7 years, which is 49 years: the husband's age is 49 years.

13. The difference between $\frac{5}{6}$ and $\frac{3}{5}$ is $\frac{25}{30}$ less $\frac{18}{30}$, or $\frac{7}{30}$; if 14 is $\frac{7}{30}$ of the number, $\frac{1}{30}$ is $\frac{1}{7}$ of 14, which is 2, and $\frac{30}{30}$ is 30 times 2, which is 60: the number is 60.

14. When Charles is $\frac{2}{5}$ older, his age will be $\frac{7}{5}$ of his

present age; if $\frac{7}{8}$ of his present age is 21 years, $\frac{1}{8}$ is $\frac{1}{7}$ of 21 years, which is 3 years, and $\frac{8}{8}$, or his age, is 5 times 3 years, which is 15 years: Charle's age is 15 years.

18. If \$90 is $\frac{1}{5}$ more than the cost, \$90 is $\frac{6}{5}$ of the cost; if \$90 is $\frac{6}{5}$ of the cost, $\frac{1}{5}$ is $\frac{1}{6}$ of \$90, which is \$15, and $\frac{5}{5}$, or the cost, is 5 times \$15, which is \$75: the horse cost \$75.

19. If \$30 is $\frac{3}{7}$ more than the cost of the dress, \$30 is $\frac{10}{7}$ of the cost of the dress; if \$30 is $\frac{10}{7}$ of the cost, $\frac{1}{7}$ is $\frac{1}{10}$ of \$30, which is \$3, and $\frac{7}{7}$, or the cost, is 7 times \$3, which is \$21: the dress cost \$21.

21. If $\frac{3}{5}$ of 45 years, or 27 years, is $\frac{8}{7}$ of the wife's age, $\frac{1}{7}$ of her age is 9 years, and $\frac{7}{7}$ of her age is 7 times 9 years, which is 63 years: the wife's age is 63 years.

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22. If 9 years, Harry's age, is $\frac{3}{4}$ of Charles's age, $\frac{1}{4}$ of Charles's age is $\frac{1}{3}$ of 9 years, or 3 years, and $\frac{4}{4}$, or his age, is 4 times 3 years, which is 12 years; Samuel's age, being $\frac{5}{6}$ of Charles's, is $\frac{5}{6}$ of 12 years, which is $7\frac{1}{2}$ years: Charles is 12 years old and Samuel $7\frac{1}{2}$ years old.

23. If the cost of the chain was $\frac{3}{7}$ of the cost of the watch, the cost of the watch and chain together (\$150) was $\frac{7}{7}$ plus $\frac{3}{7}$, or $\frac{10}{7}$ of the cost of the watch; if $\frac{10}{7}$ of the cost of the watch was \$150, $\frac{1}{7}$ of its cost was $\frac{1}{10}$ of \$150, or \$15, and $\frac{7}{7}$, or its cost, was 7 times \$15, which is \$105; if the cost of the watch was \$105, the cost of the chain was $\frac{3}{7}$ of \$105, which is \$45.

24. If to A's age there be added $\frac{2}{5}$ and $\frac{2}{5}$ of his age, the sum will be $\frac{15}{15} + \frac{10}{15} + \frac{6}{15}$ of his age, which is $\frac{31}{15}$ of his age; if $\frac{31}{15}$ of A's age is 62 years, $\frac{1}{15}$ is $\frac{1}{31}$ of 62 years, which is 2 years, and $\frac{15}{15}$ is 15 times 2 years, which is 30 years: A's age is 30 years.

25. The three fields contain $\frac{2}{3} + \frac{1}{6} + \frac{1}{4}$ of the sheep, which is $\frac{8}{36} + \frac{6}{36} + \frac{9}{36}$, or $\frac{23}{36}$, of the sheep; if $\frac{23}{36}$ of the

sheep are in three fields, the fourth field contains $\frac{36}{36}$ less $\frac{23}{36}$, or $\frac{13}{36}$ of the sheep; if $\frac{13}{36}$ of the sheep is 52 sheep $\frac{1}{36}$ is $\frac{1}{13}$ of 52 sheep, which is 4 sheep, and $\frac{36}{36}$, or the number of sheep, is 36 times 4 sheep, which is 144 sheep: there are 144 sheep in the 4 fields.

26. $\frac{2}{7}$ of the cost of the harness was $\frac{2}{7}$ of \$35, which is \$10, and, if $\frac{5}{8}$ of the cost of the bridle was \$10, $\frac{1}{8}$ of its cost was $\frac{1}{5}$ of \$10, which is \$2, and $\frac{8}{8}$, or its cost, was 8 times \$2, which is \$16.

27. If $\frac{5}{6}$ of a man's age, plus 15 years, is $\frac{5}{4}$ of his age, 15 years is the difference between $\frac{5}{4}$ and $\frac{5}{6}$ of his age, which is $\frac{5}{12}$ of his age: if $\frac{5}{12}$ of his age is 15 years, $\frac{1}{12}$ of his age is 3 years, and $\frac{12}{12}$, or his age, is 12 times 3 years, which is 36 years.

28. $\frac{1}{23}$ of 138 miles is 6 miles, and $\frac{15}{23}$ is 15 times 6 miles, which is 90 miles; if $\frac{3}{4}$ of the distance from Columbus to Cincinnati is 90 miles, $\frac{1}{4}$ of the distance is 30 miles and $\frac{4}{4}$, or the distance, is 120 miles.

30. If $\frac{3}{8}$ of the value of the house equals $\frac{4}{5}$ of the value of the lot, $\frac{1}{8}$ of the value of the house equals $\frac{2}{5}$ of the value of the lot, and $\frac{8}{8}$, or its value, equals $\frac{8}{5}$ of the value of the lot, and hence the value of both house and lot is $\frac{8}{5}$ plus $\frac{5}{5}$, or $\frac{11}{5}$, of the value of the lot; if $\frac{11}{5}$ of the value of the lot is \$4400, $\frac{1}{5}$ is \$400, and $\frac{5}{5}$, or its value, is \$2000; the value of the house is $\frac{8}{5}$ of \$2000, which is \$2400.

31. If $\frac{2}{3}$ of A's money equal $\frac{6}{7}$ of B's, $\frac{1}{3}$ of A's is $\frac{1}{2}$ of $\frac{6}{7}$, or $\frac{3}{7}$ of B's, and $\frac{3}{3}$ of A's is $\frac{21}{7}$ of B's; if both together have \$340, $\frac{21}{7}$ of B's plus $\frac{7}{7}$ of B's, or $\frac{34}{7}$ of B's is \$340; if $\frac{34}{7}$ of B's is \$340, $\frac{1}{7}$ of B's is $\frac{1}{34}$ of \$340, which is \$10, and $\frac{7}{7}$ of B's is 7 times \$10, which is \$70; if B's money is \$70, A's money is $\frac{21}{7}$ of \$70, which is \$270.

32. If $\frac{3}{4}$ of A's age is $\frac{3}{5}$ of B's, $\frac{1}{4}$ of A's age is $\frac{1}{5}$ of B's, and A's age is $\frac{4}{5}$ of B's age, or $\frac{4}{5}$ of 20 years, which is 16 years: A's age is 16 years. Or, $\frac{3}{5}$ of B's age is $\frac{3}{5}$ of 20 years, which is 12 years, and if $\frac{3}{4}$ of A's age is 12 years, $\frac{1}{4}$ of A's age is 4 years, and his age is 16 years.

33. If $\frac{2}{7}$ of a yard of velvet cost $\$2\frac{2}{3}$, or $\$\frac{8}{3}$, $\frac{1}{7}$ of a yard will cost $\$\frac{4}{3}$, and $\frac{7}{7}$, or a yard, 7 times $\$\frac{4}{3}$, which is $\$\frac{28}{3}$, or $\$9\frac{1}{3}$; if a yard cost $\$9\frac{1}{3}$, $\frac{1}{9}$ of a yard will cost $\frac{1}{9}$ of $\$9\frac{1}{3}$, which is $\$4\frac{4}{27}$; $\frac{2}{3}$ of a yard will cost $\frac{2}{3}$ of $\$9\frac{1}{3}$, which is $\$6\frac{2}{9}$; and $1\frac{1}{3}$ yards will cost $1\frac{1}{3}$ times $\$9\frac{1}{3}$, which is $\$12\frac{4}{9}$.

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38. If the cost of $\frac{3}{4}$ of a yard of silk be $\$1\frac{1}{5}$, or $\$\frac{6}{5}$, the cost of $\frac{1}{4}$ of a yard is $\$\frac{2}{5}$, and the cost of $\frac{4}{4}$, or a yard, is $\$\frac{8}{5}$, and as many yards can be bought for \$8 as $\$\frac{8}{5}$ is contained times in \$8, which is 5; as many yards can be bought for \$10 as $\$\frac{8}{5}$ is contained times in \$10, which is $6\frac{1}{4}$; as many yards for $\$9\frac{3}{5}$, or $\$\frac{48}{5}$, as $\$\frac{8}{5}$ is contained times in $\$\frac{48}{5}$, which is 6: hence 5 yards can be bought \$8, $6\frac{1}{4}$ yards for \$10, and 6 yards for $\$9\frac{3}{5}$.

40. If a train of cars run $\frac{3}{5}$ of a mile in $1\frac{7}{7}$, or $\frac{9}{7}$ of a minute, it runs $\frac{1}{5}$ of a mile in $\frac{3}{7}$ of a minute, and $\frac{5}{5}$, or a mile, in $\frac{15}{7}$ of a minute, and hence it will run as many miles in $6\frac{3}{7}$, or $\frac{45}{7}$, minutes, as $\frac{15}{7}$ is contained times in $\frac{45}{7}$, which is 3; as many miles in $10\frac{5}{7}$ or $\frac{75}{7}$ minutes, as $\frac{15}{7}$ is contained times in $\frac{75}{7}$, which is 5; as many miles in 15 minutes as $\frac{15}{7}$ is contained times in 15, which is 7; and as many miles in 30 minutes as $\frac{15}{7}$ is contained times in 30, which is 14.

41. If 4 pounds of coffee cost $\$\frac{8}{5}$, 1 pound cost $\frac{1}{4}$ of $\$\frac{8}{5}$, which is $\$\frac{2}{5}$; if a pound cost $\$\frac{2}{5}$, 6 pounds will cost 6 times $\$\frac{2}{5}$, which is $\$1\frac{1}{5}$; 10 pounds, 10 times $\$\frac{2}{5}$, which is $\$2\frac{2}{5}$; 7 pounds, 7 times $\$\frac{2}{5}$, which is $\$1\frac{4}{5}$; and 12 pounds, 12 times $\$\frac{2}{5}$, which is $\$2\frac{2}{5}$.

42. If $12\frac{1}{2}$ tons of hay will feed 5 horses a year, $\frac{1}{5}$ of $12\frac{1}{2}$ tons, or $2\frac{1}{2}$ tons, will feed 1 horse a year, and 8 times $2\frac{1}{2}$ tons, or 20 tons, will feed 8 horses; and 12 times $2\frac{1}{2}$ tons, or 30 tons, will feed 12 horses.

43. If a rod 5 feet long casts a shadow $8\frac{1}{3}$ feet long, each foot of the rod casts a shadow $\frac{1}{5}$ of $8\frac{1}{3}$ feet, which is $\frac{5}{3}$ of a foot, and if a pole, at the same time of day,

casts a shadow $17\frac{1}{2}$ feet long, the pole must be as many feet long as $\frac{5}{8}$ of a foot is contained times in $17\frac{1}{2}$ feet, which is $10\frac{1}{2}$. Or, since 5 feet, divided by $8\frac{1}{8}$, is $\frac{1}{2}\frac{5}{5}$, or $\frac{3}{5}$, the length of the rod is $\frac{3}{5}$ of the length of its shadow, and since, at the same time of day, the length of the pole is $\frac{3}{5}$ of the length of its shadow, the length of the pole is $\frac{3}{5}$ of $17\frac{1}{2}$ feet, which is $10\frac{1}{2}$ feet.

44. Since it will take 1 man 3 times as long as 3 men to do the work, it will take 1 man 3 times $10\frac{3}{4}$ days, which is $32\frac{1}{4}$ days; and it will take 8 men $\frac{1}{8}$ of the time of 1 man, or $\frac{1}{8}$ of $32\frac{1}{4}$ days which is $4\ \frac{1}{3}\frac{1}{2}$ days.

45. If a barrel of flour will supply 12 persons $4\frac{3}{5}$ days, it will supply 1 person 12 times $4\frac{3}{5}$ days, which is $55\frac{1}{5}$ days, and it will supply 7 persons $\frac{1}{7}$ of $55\frac{1}{5}$ days, which is $7\frac{8}{3}\frac{1}{5}$ days; and it will supply 10 persons $\frac{1}{10}$ of $55\frac{1}{5}$ days, which is $5\frac{5}{2}\frac{3}{5}$ days.

46. If A can do a job of work in 12 days, he can do $\frac{1}{12}$ of it in 1 day, and if B can do the job in 10 days, he can do $\frac{1}{10}$ of it in a day, and hence A and B together can do $\frac{1}{12}$ plus $\frac{1}{10}$, or $\frac{1}{6}\frac{1}{0}$ of the job in 1 day, and it will take both of them as many days to do the entire job as $\frac{1}{6}\frac{1}{0}$ is contained times in $\frac{6}{6}\frac{0}{0}$, which is $5\frac{5}{1}\frac{5}{1}$. It will take A and B $5\frac{5}{11}$ days.

47. If A and B can do the work in 8 days, they can do $\frac{1}{8}$ of it in one day, and if A can do it in 12 days, he can do $\frac{1}{12}$ of it in one day, and hence B alone can do in one day the difference between $\frac{1}{8}$ and $\frac{1}{12}$ of the work, which is $\frac{1}{24}$ of it: if B can do $\frac{1}{24}$ of the work in one day, it will take him as many days to do the work as $\frac{1}{24}$ is contained times in $\frac{2}{2}\frac{4}{4}$, which is 24.

49. The adding of the same number to both terms of a proper fraction *increases* its value, and the subtracting of the same number from both terms of a proper fraction *decreases* its value. If, for example, 5 be added to both terms of $\frac{3}{5}$, the resulting fraction is $\frac{8}{10}$, *which is greater* than $\frac{3}{5}$ $(\frac{6}{10})$, but if 2 be subtracted

from both terms of $\frac{3}{5}$, the resulting fraction is $\frac{1}{3}$, which is *less* than $\frac{3}{5}$.

NOTE.—This will be found true whatever proper fraction be taken, and the principle may be proved by Algebra.

50. The adding of the same number to both terms of an improper fraction *decreases* its value, and the subtracting of the same number from both terms of an improper fraction *increases* its value. If, for example, 3 be added to both terms of $\frac{5}{4}$, the resulting fraction will be $\frac{8}{7}$, which is *less* than $\frac{5}{4}$ ($\frac{8}{7} = \frac{32}{28}$; $\frac{5}{4} = \frac{35}{28}$); and if 3 be subtracted from both terms of $\frac{5}{4}$, the resulting fraction will be $\frac{2}{1}$, which is *greater* than $\frac{5}{4}$.

NOTE.—If the same number be added to or subtracted from both terms of an improper fraction which equals 1 or unity, as $\frac{7}{7}$, the value of the fraction will not be changed. If both terms of any fraction be *multiplied* or *divided* by the same number, the value of the fraction will not be changed.

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59. $21\frac{3}{4}$ A. + $34\frac{2}{3}$ A. + $45\frac{7}{8}$ A. + $56\frac{5}{6}$ A. + $29\frac{1}{2}$ A. = $188\frac{5}{8}$ A.

60. $786\frac{1}{2}$ sq. yd. ÷ $30\frac{1}{4}$ sq. yd. = $\frac{31146}{4} \div \frac{121}{4} = 26$, no. of sq. yd.

61. $75\frac{2}{3}$ mi. ÷ $5\frac{3}{4}$ mi. = $\frac{227}{3} \div \frac{23}{4} = 13\frac{11}{69}$, no. of hours.

62. \$52 ÷ $8\frac{2}{3}$ = $52 \div \frac{26}{3} = 6$, no. of tons.

63. \$68 ÷ $\frac{4}{15}$ = \$255, cost of 1 acre;
\$255 × 8 = \$2040, cost of 8 acres.

64. \$3$\frac{4}{7}$ ÷ $\frac{5}{8}$ = \$$\frac{25}{7}$ × $\frac{8}{5}$ = \$5$\frac{5}{7}$, cost of 1 yard;
\$196$\frac{4}{7}$ ÷ \$5$\frac{5}{7}$ = $\frac{1376}{7} \div \frac{40}{7} = 34\frac{2}{5}$, number of yards.

65. $\frac{5}{7}$ of $\frac{12}{25} = \frac{5}{7} \times \frac{12}{25} = \frac{12}{35}$; $\frac{35}{35} - \frac{12}{35} = \frac{23}{35}$;
$69 \div \frac{23}{35} = \frac{69 \times 35}{23} = 105$, the number.

66. $\frac{5}{12} + \frac{3}{8} = \frac{19}{24}$, part of journey traveled in 2 days;
$\frac{24}{24} - \frac{19}{24} = \frac{5}{24}$, part of journey traveled in 3d day;
24 mi. ÷ $\frac{5}{24} = \frac{24 \text{ mi.} \times 24}{5} = 115\frac{1}{5}$ mi., length of the journey.

67. $\$350 \div \frac{14}{55} = \$\frac{350 \times 55}{14} = \$1375$, income.

Or, $(\$350 \div 14) \times 55 = \$25 \times 55 = \$1375$, income.

68. $\$4860 \div \frac{12}{35} = \$\frac{4860 \times 35}{12} = \$14175$, value of estate.

Or, $(\$4860 \div 12) \times 35 = \$405 \times 35 = \$14175$, value of estate.

69. $\frac{15}{15} - \frac{7}{15} = \frac{8}{15}$, part of school composed of boys;

$208 \div \frac{8}{15} = \frac{208 \times 15}{8} = 390$, number of pupils.

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70. $\frac{3}{7}$ of $\frac{5}{9} = \frac{3}{7} \times \frac{5}{9} = \frac{5}{21}$, part of ship sold for \$3480;

$\$3480 \div \frac{5}{21} = \$\frac{3480 \times 21}{5} = \$14616$, value of ship.

71. $\frac{2}{5}$ of $\frac{3}{5} = \frac{6}{25}$, part of mill sold to B;

$\frac{3}{5} - \frac{6}{25} = \frac{9}{25}$, part then owned by A;

$\frac{1}{2}$ of $\frac{9}{25} = \frac{9}{50}$, part sold to C for \$460;

$\$460 \div \frac{9}{50} = \$\frac{460 \times 50}{9} = \$2555\frac{5}{9}$, value of mill.

72. $\frac{7}{12} + \frac{7}{16} = \frac{49}{48}$, part of section owned by A and B;

$\frac{3}{7}$ of $\frac{49}{48} = \frac{7}{16}$, part of section owned by C.

73. $\frac{3}{7}$ of $\frac{2}{3} = \frac{2}{7}$, part of factory sold to B;

$\frac{2}{5}$ of $\frac{2}{3} = \frac{4}{15}$, part of factory sold to C;

$\frac{2}{7} + \frac{4}{15} = \frac{58}{105}$, part of factory sold to B and C;

$\frac{2}{3} - \frac{58}{105} = \frac{70}{105} - \frac{58}{105} = \frac{4}{35}$, part then owned by A.

74. $\frac{3}{5}$ A's $= \frac{3}{4}$ B's; $\frac{1}{5}$ A's $= \frac{1}{4}$ B's; A's $= \frac{5}{4}$ B's;

B's $+ \frac{5}{4}$ B's $= \frac{9}{4}$ B's $= 396$ acres;

396 acres $\div \frac{9}{4} = 176$ acres, B's farm;

396 acres $- 176$ acres $= 220$ acres, A's farm.

Or, $\frac{5}{4}$ of 176 acres $= 220$ acres, A's farm.

75. $\frac{3}{8}$ of $\$6160 = \$2310$, A's share;

$\frac{5}{11}$ of $\$6160 = \$2800$, B's share;

$\$2310 + \$2800 = \$5110$, A's and B's share;

$\$6160 - \$5110 = \$1050$, C's share.

Or, $\frac{88}{88} - (\frac{3}{8} + \frac{5}{11}) = \frac{88}{88} - \frac{73}{88} = \frac{15}{88}$, C's share of stock;

$\frac{15}{88}$ of $\$6160 = \$1050$, C's share of profit.

76. $\frac{5}{5} - \frac{5}{8} = \frac{3}{8}$; $\frac{3}{5}$ of $\frac{3}{8} = \frac{9}{40}$, part damaged by water;

$\frac{3}{8} - \frac{9}{40} = \frac{3}{20}$, part uninjured (sold for \$5280);

$\$5280 \div \frac{3}{20} = \$35200$, cost of stock.

77. $\frac{5}{5} - \frac{2}{5} = \frac{3}{5}$; $\frac{1}{3}$ of $\frac{3}{5} = \frac{1}{5}$, part paid for repairs;
$\frac{3}{5} - \frac{1}{5} = \frac{2}{5}$; $\frac{1}{3}$ of $\frac{2}{5} = \frac{2}{15}$, part paid for stock;
$\frac{2}{5} - \frac{2}{15} = \frac{4}{15}$; $\frac{1}{2}$ of $\frac{4}{15} = \frac{2}{15}$, part paid for utensils;
$\frac{4}{15} - \frac{2}{15} = \frac{2}{15}$, part left, equal to \$650;
\$650 $\div \frac{2}{15} =$ \$4875, amount of money at first.
Or, $\frac{3}{5} \times \frac{2}{3} \times \frac{2}{3} \times \frac{1}{2} = \frac{2}{15}$, part left;
\$650 $\div \frac{2}{15} =$ \$4875, amount of money at first.

N. B.—The successive fractional factors in the second solution denote the fractional part *left* after each expenditure.

78. $3\frac{3}{4} + 2\frac{7}{8} + 1\frac{1}{8} = 8\frac{17}{40}$, number of yards in 1 coat, 1 pair of pants, and 1 vest, or in 1 suit;
$67\frac{2}{5}$ yds. $\div$ $8\frac{17}{40}$ yds. = 8, no. of each, or no. of suits.

79. $\frac{3}{8} + \frac{3}{10} = \frac{27}{40}$; $\frac{40}{40} - \frac{27}{40} = \frac{13}{40}$, sister's share;
$\frac{3}{8} - \frac{13}{40} = \frac{1}{20}$, difference between elder brother's share and sister's share;
\$450 $\div \frac{1}{20} =$ \$450 $\times$ 20 = \$9000, entire estate;
\$9000 $\times \frac{3}{8} =$ \$3375, elder brother's share;
\$9000 $\times \frac{3}{10} =$ \$2700, younger brother's share.

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1. $\frac{3}{125} = \frac{3.000}{125} = .024$.
2. $\frac{7}{2500} = \frac{7.0000}{2500} = .0028$.
3. $.325 = \frac{325}{1000} = \frac{13}{40}$.
4. $.0045 = \frac{45}{10000} = \frac{9}{2000}$.

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5. 67.5 + .54 = 68.04, sum;
67.5 — .54 = 66.96, difference;
68.04 — 66.96 = 1.08.
6. 64.5 + .015 = 64.515, sum;
64.5 × .015 = .9675, product;
64.515 — .9675 = 63.5475.
7. 6.25 + .075 = 6.325, sum;
6.25 — .075 = 6.175, difference;
6.325 × 6.175 = 39.056875.

8. $.032 \times .005 = .00016$;
$.0512 \div .00016 = 320.$

9. $25.6 \div .064 = 400$;
$32.4 \times .015 = .486$;
$400. - .486 = 399.514.$

10. $\$5.33 \times 2.5 = \$13.325$;
$\$13.325 \div .075 = \$177.66\frac{2}{3}.$

11. $.0825 \times 1.25 = .103125$;
$.006\frac{1}{4} \times .016 = .0001$;
$.103125 \div .0001 = 1031.25.$

12. $.000015 \times 7000000 = 105.$

13. $.0000016 \div .025 = .000064.$

14. $205000000 \div .0041 = 50000000000.$

15. $.54 \times 2.5 = 1.35$, product of the two decimals;
$.0189 \div 1.35 = .014$, third decimal.

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13. $\$900 + \$1200 + \$750 = \$2850$, value of city lots;
$\$3075 - \$2850 = \$225$, difference paid in money.

14. $\$325 + \$450.80 + \$200.60 + \$245 = \$1221.40$, expenses;
$\$1600 - \$1221.40 = \$378.60$, amount left.

15. $\$75 + \$230.80 + \$180.40 + \$95 = \$581.20$, amount deposited;
$\$40 + \$87.50 + \$331.45 + \$20.15 + \$18.60 = \$497.70$, amount drawn out;
$\$581.20 - \$497.70 = \$83.50$, bank balance.

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13. $\$1163.250 \div \$12.375 = 94$, number of tons.

14. 278 lb. + 309 lb. + 327 lb. = 914 lb., weight of hogs.
$\$.075 \times 914 = \$68.55$, amount received.

15. \$.30 × 536 = \$160.80, for butter;
\$.16⅔ × 1200 = \$200.00, for cheese;
\$8.75 × 19 = \$166.25, for hay;
\$527.05, total receipts.

16. \$81 + \$525 = \$606, total cost;
\$.18 × 540 = \$97.20, sale receipts for coffee;
\$1.60 × 420 = \$672., sales receipts for tea;
\$672. + \$97.20 = \$769.20, total sale receipts;
\$769.20 − \$606 = \$163.20, gain.

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26. (1) \$1600, cost at \$1;
\$400, cost at 25 cts.;
200, cost at 12½ cts.;
\$600, cost at 37½ cts.

27. (4) \$2464, cost at \$1;
1232, cost at 50 cts.;
308, cost at 12½ cts.;
\$4004, cost at \$1.62½.

28. (5) \$1250., cost at \$1;
625., cost at 50 cts.;
312.50, cost at 25 cts.;
156.25, cost at 12½ cts.;
\$2343.75, cost at \$1.87½.

29. (1) \$640, cost at \$1;
\$320, cost at 50 cts.;
160, cost at 25 cts.;
80, cost at 12½ cts.;
\$560, cost at 87½ cts.

30. (4) \$1.00 ÷ \$.25 = 4, number of dozens for \$1;
4 doz. × 105 = 420 dozens.

31. \$1.00 ÷ \$.33⅓ = 3, no. yards for \$1;
3 yards × 120 = 360 yards.

33. \$.15, cost of 1 lb.;
\$1.35, cost of 9 lb.;
.075, cost of 8 oz. ($\frac{1}{2}$ lb.);
.0375, cost of 4 oz. ($\frac{1}{4}$ of 8 oz.);
.009$3\frac{3}{4}$, cost of 1 oz. ($\frac{1}{4}$ of 4 oz.);
\$1.4718$\frac{3}{4}$, cost of 9 lb. 13 oz.

34.
\$.90, cost of 1 gallon.
\$14.40, " " 16 "
.45, " " 2 qt. ($\frac{1}{2}$ gal.)
.225, " " 1 qt.
\$15.075, " " 16 gal. 3 qt.

35.
\$ 4.25, cost of 1 bushel.
\$29.75, " " 7 "
2.125, " " 2 pk. ($\frac{1}{2}$ bu.)
1.0625, " " 1 pk.
.53125, " " 4 qt. ($\frac{1}{2}$ pk.)
\$33.46875, " " 7 bu. 3 pk. 4 qt.

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2.
\$2.75 × 24 = \$66.00
.06$\frac{1}{4}$ × 21 = 1.31$\frac{1}{4}$
2.50 × 5.40 = 13.50
4.33$\frac{1}{3}$ × 4 = 17.33$\frac{1}{3}$
\$98.14$\frac{7}{12}$
\$25 + \$44 + \$15 = 84.00, amount of credits.
\$14.14$\frac{7}{12}$, amount of due-bill.

3.
\$.16$\frac{2}{3}$ × 23 = \$3.83$\frac{1}{3}$
12$\frac{1}{2}$ × 45 = 5.62$\frac{1}{2}$
1.62$\frac{1}{2}$ × 12 = 19.50
.45 × 8 = 3.60
1.37$\frac{1}{2}$ × 2 = 2.75
.75 × 6 = 4.50
\$39.80$\frac{5}{6}$, amount of bill.

4.

11c.	× 45 =	$4.95
4½c.	× 48 =	2.16
27c.	× 36 =	9.72
28c.	× 17 =	4.76
7½c.	× 15 =	1.12½
14c.	× 36 =	5.04
12½c.	× 8 =	1.00
95c.	× 25 =	23.75
		$52.50½, amount of bill.

5.

$6.45	× 7 =	$45.15
3.75	× 6 =	22.50
5.25	× 5 =	26.25
6.95	× 13 =	90.35
4.10	× 20 =	82.00
.24	× 16 =	3.84
		$270.09, amount.

Oct.	9,	$50.	
Dec.	1,	75.	
Dec.	10,	50.	
Dec.	15,	25.	200.00, amount of credits.
			$70.09, face of due-bill.

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23. $\frac{1}{24}$ yd. = $\frac{1 \cdot 3}{24}$ ft. = $\frac{1 \cdot 3 \times 3 \times 12}{24}$ in. = 19½ in.

24. $\frac{11}{12}$ lb. = $\frac{11 \times 12}{12}$ oz. = 11 oz. = 11 × 20 pwt. = 220 pwt.

25. .0065 w. = .0065 × 7 da. = .0455 da. = .0455 × 24 h. = 1.092 h.

6. 9.6 pwt. = $\frac{9 \cdot 6}{20}$ oz. = .48 oz. = $\frac{.48}{12}$ lb. = .04 lb.

27. 3.96 in. = $\frac{3 \cdot 96}{12}$ ft. = .33 ft. = $\frac{.33}{16 \cdot 5}$ rd. = .02 rd.

28. 30.8 rd. = $\frac{30 \cdot 8}{320}$ mi. = .09625 mi., or .09$\frac{5}{8}$ mi.

29. .096 bu. = .096 × 4 pk. = .096 × 4 × 8 qt. = .096 × 4 × 8 × 2 pt. = 6.144 pt.

30. $\frac{20}{33}$ rd. = $\frac{20}{33\times320}$ mi. = $\frac{20}{33\times320\times3}$ lea. = $\frac{1}{1584}$ lea.

31. $\frac{8}{9}$ min. = $\frac{8}{9\times60}$ h. = $\frac{8}{9\times60\times24}$ da. = $\frac{1}{1620}$ da.

32. 11.2 sq. rd. = $\frac{11.2}{160}$ A. = .07 A.

33. $56\frac{5}{8}$ lb. = $56\frac{5}{8}\times12\times20\times24$ gr. = 326160 gr.

34. $\frac{11}{120}$ gal. = $\frac{11\times4}{120}$ qt. = $\frac{11\times4\times2}{120}$ pt. = $\frac{11}{15}$ pt.

35. 2.43 mi. = 2.43 × 320 × $16\frac{1}{2}$ ft. = 12830.4 ft.

36. 1.408 ft. = $\frac{1.408}{16.5}$ rd. = $\frac{1.408}{16.5\times320}$ mi. = .00026$\frac{2}{3}$ mi.

37. 143.35 sq. in. = $\frac{143.35}{144\times9\times30¼}$ sq. rd. = .00365+ sq. rd.

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14. $\frac{7}{9}$ mi. = $\frac{7\times320}{9}$ rd. = $248\frac{8}{9}$ rd.;
$\frac{8}{9}$ rd. = $\frac{8\times5½}{9}$ yd. = $4\frac{8}{9}$ yd.;
$\frac{8}{9}$ yd. = $\frac{8\times3}{9}$ ft. = $2\frac{2}{3}$ ft.;
$\frac{2}{3}$ ft. = $\frac{2\times12}{3}$ in. = 8 in.;
$\frac{7}{9}$ mi. = 248 rd. 4 yd. 2 ft. 8 in.

15. $\frac{5}{12}$ w. = $\frac{5\times7}{12}$ da. = $2\frac{11}{12}$ da.;
$\frac{11}{12}$ da. = $\frac{11\times24}{12}$ h. = 22 h.;
$\frac{5}{12}$ w. = 2 da. 22 h.

16. $\frac{7}{15}$ lb. = $\frac{7\times12}{15}$ oz. = $5\frac{3}{5}$ oz.;
$\frac{3}{5}$ oz. = $\frac{3\times20}{5}$ pwt. = 12 pwt.;
$\frac{7}{15}$ lb. = 5 oz. 12 pwt.

17. $\frac{13}{16}$ rd. = $\frac{13\times5½}{16}$ yd. = $4\frac{15}{32}$ yd.;
$\frac{15}{32}$ yd. = $\frac{15\times3}{32}$ ft. = $1\frac{13}{32}$ ft.;
$\frac{13}{32}$ ft. = $\frac{13\times12}{32}$ in. = $4\frac{7}{8}$ in.;
$\frac{13}{16}$ rd. = 4 yd. 1 ft. $4\frac{7}{8}$ in.

18. $\frac{11}{12}$ A. = $\frac{11\times160}{12}$ sq. rd. = $146\frac{2}{3}$ sq. rd.

19. $\frac{7}{8}$ bu. = $\frac{7\times4}{8}$ pk. = $3\frac{1}{2}$ pk.; $\frac{1}{2}$ pk. = $\frac{1\times8}{2}$ qt. = 4 qt.;
$\frac{7}{8}$ bu. = 3 pk. 4 qt.

20. .85 lb. = .85 × 16 oz. = 13.6 oz.

NOTE.—.6 oz. = 9.6 drams; but the dram, being seldom used, is not given in the New Complete Arithmetic as one of the denominations of avoirdupois weight.

21. .325 T. = .325 × 20 cwt. = 6.5 cwt.; .5 cwt. = 50 lb.
22. .08⅓ yd. = .08⅓ × 3 ft. = .25 ft. = .25 × 12 in. = 3 in.
23. .9375 gal. = .9375 × 4 qt. = 3.75 qt.;
.75 qt. = .75 × 2 pt. = 1.5 pt.;
.5 pt. = .5 × 4 gi. = 2 gi.;
.9375 gal. = 3 qt. 1 pt. 2 gi.
24. .5625 cwt. = 56.25 lb.; .25 lb. = .25 × 16 oz. = 4 oz.
25. .0135 da. = .324 h. = 19.44 min.; .44 min. = 26.4 sec.

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11. 1 rd. = 5½ × 3 × 12 in. = 198 in.;
1 yd. 2 ft. 6 in. = 66 in.;
66 in. ÷ 198 in. = $\frac{66}{198} = \frac{1}{3}$, part of rod.
12. 1 bu. = 4 × 8 × 2 pt. = 64 pt.;
1 pk. 2 qt. 1⅕ pt. = 21⅕ pt.;
21⅕ pt. ÷ 64 pt. = $\frac{106}{320} = \frac{53}{160}$, part of bushel.
13. 9 h. 36 min. = 9.6 h.; 9.6 h. = .4 da. = .001$\frac{7}{73}$ yr.
14. 2 pk. 3 qt. 1.2 pt. = 2 pk. 3.6 qt. = 2.45 pk. = 125 bu. Or, 1.2 pt. = .6 qt.; 3.6 qt. = .45 pk.;
2.45 pk. = .6125 bu.
15. 8 oz. 8 pwt. = 8.4 oz. = .7 lb.
Or, 8 pwt. = .4 oz.; 8.4 oz. = .7 lb.
16. 18 rd. 1 yd. = 18$\frac{2}{11}$ rd.; 18$\frac{2}{11}$ rd. = .0568$\frac{2}{11}$ mi.
Or, 1 yd. = .1818$\frac{2}{11}$ rd.; 18.1818$\frac{2}{11}$ rd. = .0568$\frac{2}{11}$ mi.
17. 1 bu. 3 pk. = 56 qt.; 5 pk. 6 qt. = 46 qt.
46 qt. ÷ 56 qt. = $\frac{46}{56} = \frac{23}{28}$.
18. 3 w. 4 da. = 600 h.; 3 da. 8 h. = 80 h.;
80 h. ÷ 600 h. = $\frac{80}{600} = \frac{2}{15}$.
19. 12 A. 80 P. = 2000 P.; 1 A. 90 P. = 250 P.;
250 P. ÷ 2000 P. = $\frac{250}{2000} = \frac{1}{8}$.
20. 3 bbl. = 3 × 196 × 16 oz. = 9408 oz.;
110 lb. 4 oz. = 1764 oz.;
1764 oz. ÷ 9408 oz. = $\frac{1764}{9408} = \frac{3}{16}$.
21. 2 rd. = 2 × 16½ ft. = 33 ft.; 3 yd. 2 ft. = 11 ft.;
11 ft. ÷ 33 ft. = $\frac{11}{33} = \frac{1}{3}$.

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18. $\frac{17}{25}$ da. $= \frac{17\times24}{25}$ hr. $= \frac{17\times24\times60}{25}$ min. $= 979\frac{1}{5}$ min.

19. $\frac{16}{21}$ w. $= \frac{16\times7}{21}$ da. $= \frac{16\times7\times24}{21}$ h. $= 128$ hr.

20. $\frac{7}{15}$ h. $= \frac{7}{15\times24}$ da. $= \frac{7}{360}$ da.

Or, $\frac{7}{15}$ h. $= \frac{7}{15}$ of $\frac{1}{24}$ da. $= \frac{7}{360}$ da.

21. .012 mi. $= .012 \times 320 \times 5\frac{1}{2}$ yd. $= 21.12$ yd.

22. $\frac{4}{5}$ yd. $= .8$ yd. $= \frac{.8}{5.5\times320}$ mi. $= .00045\frac{5}{11}$ mi.

23. 1 rd. $= 16\frac{1}{2} \times 12$ in. $= 198$ in.; 3 ft. 4 in. $= 40$ in.;
40 in. $\div$ 198 in. $= \frac{40}{198} = \frac{20}{99}$, part of foot.

24. $3\frac{1}{5}$ A. $= 3\frac{1}{5} \times 160$ sq. rd. $= 512$ sq. rd.;
32 sq. rd. $\div$ 512 sq. rd. $= \frac{32}{512} = \frac{1}{16}$, fractional part.

25. 1 w. $= 7 \times 24$ h. $= 168$ h.; 8 h. 24 mi. $= 8.4$ h.;
8.4 h. $\div$ 168 h. $= \frac{84}{16\,80} = \frac{1}{20}$, fractional part.

26. $7\frac{1}{4}$ in. $\times$ 240 $= 1740$ in. $= 145$ ft.

27. 1 lb. 10 oz. $= 10560$ gr.; 4 pwt. 15 gr. $= 111$ gr.;
10560 gr. $\div$ 111 gr. $= 95$ (no. of rings), with 15 gr. rem.

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28. 63 gal. $= 252$ qt.; 5 gal. 1 qt. $= 21$ qt.;
252 qt. $\div$ 21 qt. $= 12$, number of kegs.

29. $\frac{5}{8}$ mi. $= \frac{5}{8} \times 320$ rd. $= 200$ rd.;
200 rd. $= 200 \times 16\frac{1}{2}$ ft. $= 3300$ ft.;
12 ft. 6 in. $= 12.5$ ft.
3300 ft. $\div$ 12.5 ft. $= 264$, number of rotations.

30. 132 bu. $= 528$ pk.; 2 bu. 3 pk. $= 11$ pk.;
528 pk. $\div$ 11 pk. $= 48$, number of barrels.

31. 1 T. $= 2000$ lb. $= 32000$ oz.; 2 lb. 3 oz. $= 51$ oz.;
32000 oz. $\div$ 51 oz. $= 627$ (no. of axes), with 23 oz. or 1 lb. 7 oz. rem.

32. 2465 lb. + 2535 lb. + 2594 lb. + 2286 lb. $= 9880$ lb.;
9880 lb. $\div$ 60 lb. $= 164\frac{2}{3}$, number of bushels;
\$.94 $\times$ $164\frac{2}{3} =$ \$154.78$\frac{2}{3}$.

33. 1000 oz. $\times$ 27 $= 27000$ oz.;
27000 oz. $= \frac{27000}{2000\times16}$ T. $= \frac{27}{32}$ T. $= .84375$ T.

34. 5 ʒ 2 ℈ = 340 gr.;
340 gr. ÷ 18 gr. = 18 (no. doses), with 16 gr. rem.

35. 1 ℥ .2 ʒ 2 ℈ = 640 gr.;
640 gr. ÷ 5 gr. = 128, no. of pills.

36. 6 gr. × 480 = 2880 gr.;
2880 gr. = $\frac{2880}{20\times3\times8}$ ℥ = 6 ℥.

37. 8 oz. 15 pwt. = 4200 gr.;
\$.75 × 4200 = \$3150.

38. $3\frac{1}{2}$ oz. = 70 pwt.; \$.75 × 70 = \$52.50, cost.

39. 16 carats fine is $\frac{16}{24}$, or $\frac{2}{3}$, gold;
$3\frac{1}{3}$ oz. × $\frac{2}{3}$ = $2\frac{2}{9}$ oz. (gold).

40. \$8.75 × 5 = \$43.75, cost;
2 bu. 3 pk. 4 qt. = 92 qt.;
92 qt. × 3 = 276 qt.; 92 qt. × 2 = 184 qt.;
12c. × 276 = \$33.12; 10c. × 184 = \$18.40;
\$33.12 + \$18.40 = \$51.52, sale receipts;
\$51.52 — \$43.75 = \$7.77, gain.

41. $15\frac{1}{4}$ lb. + $16\frac{1}{2}$ lb. + $17\frac{3}{8}$ lb. + $14\frac{5}{16}$ lb. = $63\frac{7}{16}$ lb.;
\$.085 × $63\frac{7}{16}$ = \$$5.392\frac{3}{16}$, cost;
12c. × $15\frac{1}{4}$ = \$1.83; 11c. × $16\frac{1}{2}$ = \$$1.81\frac{1}{2}$;
10c. × $17\frac{3}{8}$ = \$$1.73\frac{3}{4}$; 9c. × $14\frac{5}{16}$ = \$$1.28\frac{13}{16}$;
\$1.83 + \$$1.81\frac{1}{2}$ + \$$1.73\frac{3}{4}$ + \$$1.28\frac{13}{16}$ = \$$6.67\frac{1}{16}$, or \$$6.67\frac{10}{16}$; \$$6.67\frac{10}{16}$ — \$$5.392\frac{3}{16}$ = \$$1.278\frac{7}{16}$, gain.

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9. 37° 20′ N. + 12° 36′ N. = 49° 56′ N.;
49° 56′ N. — 15° 45′ S. = 34° 11′ N.

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15.

	mi.	rd.	yd.	ft.	in.
	30	14	3	1	4
	25	36	4	2	10
	4	297	$3\frac{1}{2}$	1	6
			$\frac{1}{2}$ = 1		6
	4	297	4	0	0

Ans. 4 mi. 297 rd. 4 yd.

16.

rd.	yd.	ft.	in.
33	0	2	11
16	3	0	8
16	$2\frac{1}{2}$	2	3
	$\frac{1}{2}$ = 1		6
16	3	0	9

Ans. 16 rd. 3 yd. 9 in.

	rd.	ft.	in.
17.	26	11	0
	18	13	9.8
	7	13½	2.2
		½ = 6	
	7	13	8.2

Or,

rd.	yd.	ft.	in.
26	3	2	0.
18	4	1	9.8
7	4½	0	2.2
	½ = 1		6
7	4	1	8.2

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	w.	da.	h.	min.	
29.	13	5	18	40	
	7	0	23	45	
	15) 6	4	18	55	sec.
		3	2	51	40

	mi.	rd.	yd.	ft.	
30.	4	23	3	2	
	7	16	0	1	
	22) 11	39	4	0	in.
		161	4	1	3 6/11

	lb.	oz.	lb.	oz.
31.	56	13	56	13
	47	15	47	15
	104	12	8	14
	8	14		
	9) 95	14		
	10	10 8/9, *Ans.*		

	da.	h.	min.	sec.
32.	365	5	48	47⅓
				7
	12) 2556	16	41	31⅓
	213	1	23	27 11/18

NOTE.—7/12 of a number is found by multiplying the number by 7 and dividing the product by 12, or by dividing the number by 12 and multiplying the quotient by 7.

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		h.	min.	sec.	
31.	(1)	4	00	00,	P. M.
			53	25	
		3	6	35,	P. M.

6 min. 35 sec. past 3 P. M.

	h.	min.	sec.	
(2)	10	00	00,	A. M.
		53	25	
	10	53	25,	A. M.

53 min. 25 sec. past 10 A. M.

32. (1)

h.	min.	sec.	
9	00	00,	A. M.
3	9	1	
5	50	59,	A. M.

50 min. 59 sec. past 5 A. M.

(2)

h.	min.	sec.	
1	00	00,	P. M.
3	9	1	
4	9	1,	P. M.

9 min. 1 sec. past 4 P. M.

33. (1) 30° long. = 2 h. in time;
6 o'clock + 2 h. = 8 o'clock.

(2) 45° long. = 3 h. in time;
6 o'clock − 3 h. = 3 o'clock.

34. (1)

15)	15°	15′
	1 h.	1 min.
	9	0
	10 h.	1 min.

1 min. past 10 o'clock.

(2)

15)	15°	45′
	1 h.	3 min.
	9 h.	00 min.
	1	3
	7 h.	57 min.

57 min. past 7 o'clock.

35. (1) 7° long. = 28 min. in time;

12 h.	00 min.	M.
	28	
11 h.	32 min.	A. M.

32 min. past 11 A. M.

(2)

15)	16°	45′
	1 h.	7 min.
	12 h.	0 min. M.
	13 h.	7 min.

7 min. past 1 P. M.

36.

13°	23′	53″	E.
71°	4′	9″	W. (add)
15)84°	28′	2″,	difference in longitude;

5 h. 37 min. $52\frac{2}{15}$ sec., difference in time.

5 o'clock 37 min. $52\frac{2}{15}$ sec. P. M., Berlin clock time.

NOTE.—The clock time at Berlin is 5 h. 37 min. $52\frac{2}{15}$ sec. faster than that of Boston, and since it is noon at Boston, it is 5 o'clock 37 min. $52\frac{2}{15}$ sec. P. M. at Berlin.

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37. 12° 27′ 14″ E.
77° 2′ 48″ W.
15) 89° 30′ 2″, difference in longitude;
5 h. 58 min. $0\frac{2}{15}$ sec., difference in time;
9 h.
14 h. 58 min. $\frac{2}{15}$ sec. past midnight.
Or, 2 o'clock 58 min. $\frac{2}{15}$ sec. P. M., clock time at Rome.

38. 2 h. 15 min. 10 sec.
15
33° 47′ 30″, difference in longitude.

39. 1 h. 2 min. 20 sec.
15
15° 35′ 00″

Or, 1 h. $2\frac{1}{3}$ min.
15
15° 35′

40. 1 h. 3 min., difference in time;
15
15° 45′, difference in longitude.
He had traveled 15° 45′ east.

41. 11 h. 30 min.
9
2 h. 30 min., difference in time;
15
37° 30′, difference in longitude.

42. 11 h. 45 min.
9 30
2 h. 15 min., difference in time;
15
(Subtract) 33° 45′, difference in longitude;
74° 00′ W., longitude of New York;
40° 15′ W., longitude of vessel.

43. 45 min. 30 sec., difference in time;
15
11° 22′ 30″, difference in longitude;
85° 40′ 00″ W., long. of eastern observatory;
97° 2′ 30″ W., long. of western observatory.

44. 5 h. 8 min. 11 sec.
42 9 [and Chicago time;
5 h. 50 min. 20 sec., diff. between Greenwich
15
87° 35′ 0″ W., longitude of Chicago.

45. (1) 84° 26′
76° 37′
15) 7° 49′, diff. in long. between B. and C.;
31 min. 16 sec. diff. in time bet. B. and C.
12 h. 31 min. 16 sec. P. M., Baltimore clock time.

(2) 87° 35′
84° 26′
15) 3° 9′
12 min. 36 sec.
12 h. 00 00
11 h. 47 min. 24 sec. A. M., [Chicago time.

(3) 122° 26′ 15″
84 26
15)38° 0′ 15″
2 h. 32 m. 1 sec.
12 00 00
9 h. 27 m. 59 sec., San [Francisco time.

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2. .6214 mi. × 44.5 = 27.6523 mi.
3. $1^{m} = 39.37$ in.; $1^{cm} = .3937$ in.;
.3937 in. × 24 = 9.4488 in.
4. $1^{hl} = .0284$ bu. × 100 = 2.84 bu.;
2.84 bu. × 250 = 710 bu.
5. $1^{l} = 1.0567$ qt. = .2641¼ gal.;
.2641¼ gal. × 37½ = 9.9065 gal.
6. 2.2046 lb. × 150 = 330.69 lb.

7. $.9463^{l} \times 35 = 33.1205^{l}$.
8. $3.624^{st} \times 20 = 72.48^{st}$.
9. $.4047^{Ha} \times \frac{3}{4} = .303525^{Ha} = 30.3525^{a}$.
10. 1 ft. $= \frac{1}{3}$ of $.9144^{m} = .3048^{m}$;
$.3048^{m} \times 1760 = 536.448^{m}$.

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1.

45.6^{m}
$3.48^{Dm} = 34.8^{m}$
$460^{dm} = 46.0^{m}$
3.6^{m}
$340^{cm} = 3.4^{m}$
133.4^{m}

2.

74.06^{l}
$88.8^{Dl} = 888.00^{l}$
$.687^{Kl} = 687.00^{l}$
$47.6^{cl} = .476^{l}$
$450^{ml} = .450^{l}$
1649.986^{l}

3. $8.46^{Kg} = 8460^{g}$; $340^{cg} = 3.4^{g}$; $6.5^{g} + 3.4^{g} = 9.9^{g}$
$8460^{g} - 9.9^{g} = 8450.1^{g} = 8.4501^{Kg}$.
4. $1^{l} = 1^{Kg}$; $1^{Kg} \times 54 = 54^{Kg}$.
5. $1^{Kg} = 1^{l}$; $1^{l} \times 94.5 = 94.5^{l}$.
6. $6^{sq.\,m} \times 2.5 = 15^{sq.\,m} = 1500^{sq.\,dm}$.
Or, $6^{m} = 60^{dm}$; $2.5^{m} = 25^{dm}$; $60^{sq.\,dm} \times 25 = 1500^{sq.\,dm}$.
7. $54^{sq.\,m} \times 30 = 1620^{sq.\,m}$;
$1620^{sq.\,m} \div 100^{sq.\,m} = 16.2$, no. of ars.
8. (2) $12.45^{sq.\,m} \times 8.6 = 107.07^{sq.\,m}$.
9. 21094.95^{Kg} (weight of 5 loads) $= 21.09495$ met. ton;
$\$14.50 \times 21.09495 = \$305.876+$, amount received.
10. (1) $6.54^{l} \times 60 = 392.4^{l} = 3.924^{Hl}$.
11. $.985^{Kg} - .380^{Kg} = .605^{Kg}$; $1^{l} \times .605 = .605^{l}$.
12. $2.4^{Hg} = 240^{g}$; $1.2^{dg} = .12^{g}$;
$240^{g} \div .12^{g} = 2000$, number of pills.
13. $47.3^{g} \div 4.3^{g} = 11$, number of rings.
14. $16.5^{l} = 16.5^{Kg}$; $16.5^{Kg} \times 1.03 = 16{,}995^{Kg}$.
15. $25.5^{Kg} \div 1.03 = 24.757^{Kg} = 24.757^{l}$; $24.757 \times 6c. = \$1.485+$.
16. $\$3.25 \times 160 = \$520$, cost;
$\$3.90 \times 80 + \$3.75 \times 80 = \$612$, receipts;
$\$612 - \$520 = \$92$, gain.

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17. \$94 × 40.65 = \$3821.10, value of land.

18. \$2.40 × 150.85 = \$362.04, sale receipts.

19. \$6.50 × 5.4 = \$35.10, cost;
$5.4^{Hl} = 540^{l}$; 8c. × 540 = \$43.20, receipts;
\$43.20 − \$35.10 = \$8.10, gain.

20. $11.6^{Km} = 11600^{m}$;
$11600^{m} \div 5.8^{m} = 2000$, no. of rotations.

21. $78^{cu.\,m} = 78000^{Ks}$; $1^{l} \times 78000 = 78000^{l}$;
$1.273^{s} \times 78000 = 99294^{s} = 99.294^{Ks}$.

22. $14.6^{l} \times 60 \times 2 = 1752^{l} = 17.52^{Hl}$.

23. $120^{l} \times 50 = 6000^{l} = 6000^{cu.\,dm} = 6^{cu.\,m}$, gas in 1 hour;
$6400^{cu.\,m} \div 6^{cu.\,m} = 1066\frac{2}{3}$, number of hours.

24. $42.5^{l} \times 8 = 340^{l}$; 5½c. × 340 = \$18.70, receipts.

25. $120^{Hl} = 12000^{l}$;
6½c. × 12000 = \$780, receipts for milk;
56c. × 450 = \$252, receipts for butter;
\$780 + \$252 = \$1032, total receipts.

26. $260^{Ks} \times 25 = 6500^{Ks}$;
18c. − 15½c. = 2½c., gain per kilo;
2½c. × 6500 = \$162.50, gain.

27. $8.5^{sq.\,m} \times 8.5 = 72.25^{sq.\,m}$;
\$.24 × 72.25 = \$17.34, cost.

28. 1.0936 yd. × 18288 = 19999.7568 yd.;
\$2.75 × 19999.7568 = \$54999.3312, sale receipts;
\$2.40 × 18288 = \$43891.20, cost;
\$54999.3312 − \$43891.20 = \$11108.1312, gain.

Or, \$2.75 × 1.0936 = \$3.0074, sale receipts per meter;
\$3.0074 − \$2.40 = \$.6074, gain per meter;
\$.6074 × 18288 = \$11108.1312, total gain.

29. 1.0567 qt. × 8808 = 9307.4136 qt. = 2326.8534 gal.;
\$.35 × 2326.8834 = \$814.39869, sale receipts;
\$.06½ × 8808 = \$572.52, cost;
\$814.39869 − \$572.52 = \$241.87869, gain.

Or, $1^{l} = 1.0567$ qt. = .264175 gal.;
\$.35 × .264175 = \$.09246⅛, receipts per liter;

$\$.09246\frac{1}{8} - \$.065 = \$.02746\frac{1}{8}$, gain per liter;
$\$.02746\frac{1}{8} \times 8808 = \$241.87869$, gain.

30. 2.2046 lb. $\times$ 4412 = 9726.695+ lb., weight;
$\$.25 \times 9726.695 = \$2431.67+$, receipts;
$\$.30 \times 4412 = \$1323.60$, cost;
$\$2431.67+ - \$1323.60 = \$1108.07+$, gain.

Or, $1^{kg} = 2.2046$ lb.;
$\$.25 \times 2.2046 = \$.55115$, receipts per kilo;
$\$.55115 - \$.30 = \$.25115$, gain per kilo;
$\$.25115 \times 4412 = \$1108.07+$, total gain.

MENSURATION.

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12. 205.14 sq. yd. $\times$ 5.5 = 1128.27 sq. yd.

13. 24 ft. $\times$ 2 + $18\frac{3}{4}$ ft. $\times$ 2 = $85\frac{1}{2}$ ft., perimeter of room;
$85\frac{1}{2}$ sq. ft. $\times$ $10\frac{1}{2}$ = $897\frac{3}{4}$ sq. ft., in walls;
24 sq. ft. $\times$ $18\frac{3}{4}$ = 450 sq. ft., in ceiling;
$897\frac{3}{4}$ sq. ft. + 450 sq. ft. = $1347\frac{3}{4}$ sq. ft.;
$1347\frac{3}{4}$ sq. ft. $\div$ 9 sq. ft. = $149\frac{3}{4}$ sq. yd., in walls and ceiling.

14. 134 sq. rd. $\times$ 52.5 = 7035 sq. rd. = $43\frac{3}{8}\frac{1}{2}$ A.

15. 208 sq. ft. $\times$ $62\frac{1}{2}$ = 13000 sq. ft. = $1444\frac{4}{9}$ sq. yd.

16. 3267 sq. yd. $\div$ 49.5 sq. yd. = 66, no. of yards long.

NOTE.—A strip 49.5 yd. long and 1 yd. wide contains 49.5 sq. yd., and the garden is as many yards long as 49.5 sq. yd. are contained times in 3267 sq. yd., which is 66.

17. 840 sq. rd. $\div$ 252 sq. rd. = $3\frac{1}{3}$, number of rods wide.

19. 33.2 yd. $\div$ 2 = 16.6 yd. ($\frac{1}{2}$ altitude);
54.5 sq. yd. $\times$ 16.6 = 904.7 sq. yd.

20. 50 rd. $\div$ 2 = 25 rd. ($\frac{1}{2}$ altitude);
80 sq. rd. $\times$ 25 = 2000 sq. rd. = $12\frac{1}{2}$ A.

21. 270 sq. in. $\div$ 36 sq. in. $= 7\frac{1}{2}$; $7\frac{1}{2}$ in. $\times 2 = 15$ in., alt.

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23. 60 yd. $\times$ 3.1416 $=$ 188.496 yd., circumference.

25. 40 ft. $\times$ 3.1416 $=$ 125.664 ft., circumference;
125.664 sq. ft. $\times$ 10 $=$ 1256.64 sq. ft.

26. 16 in. $\times$ 3.1416 $=$ 50.2656 in., circumference;
50.2656 $\times$ 4 $=$ 201.0624 sq. in., area.

27. 20 ft. $\times$ 3.1416 $=$ 62.832 ft., circumference;
62.832 sq. ft. $\times$ 5 $=$ 314.16 sq. ft., area.

28. 80 ft. $\times$ 3.1416 $=$ 251.328 ft., circumference;
251.328 sq. ft. $\times$ 20 $=$ 5026.56 sq. ft., surface.

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2. 24 ft. $\div$ 3 ft. $=$ 8, number of strips;
17 ft. 3 in. + 9 in. $=$ 18 ft. $=$ 6 yd., length;
6 yd. $\times$ 8 $=$ 48 yd.

3. $15\frac{3}{4}$ ft. $= 5\frac{1}{4}$ yd.; $\frac{21}{4}$ yd. $\div \frac{3}{4}$ yd. $= 7$, no. of strips;
$\frac{1}{8}$ yd. $= \frac{1}{8}$ ft., waste in matching;
$18\frac{1}{2}$ ft. + $\frac{1}{8}$ ft. $= 18\frac{5}{8}$ ft. $= 6\frac{5}{18}$ yd., length of carpet;
$6\frac{5}{18}$ yd. $\times 7 = 43\frac{17}{18}$ yd., in carpet.

4. 20 ft. $= 6\frac{2}{3}$ yd.;
$6\frac{2}{3}$ yd. $\div \frac{3}{4}$ yd. $= 8\frac{8}{9}$ (9 strips required);
20 ft. + 9 in. $= 20\frac{3}{4}$ ft. $= 6\frac{11}{12}$ yd., length of carpet;
$6\frac{11}{12}$ yd. $\times 9 = 62\frac{1}{4}$ yd.; \$1.60 $\times$ $62\frac{1}{4}$ = \$99.60, cost.

5. 17 ft. $\div$ 3 ft. $= 5\frac{2}{3}$ (6 strips required);
20 ft. $= 6\frac{2}{3}$ yd., length of carpet;
$6\frac{2}{3}$ yd. $\times$ 6 $=$ 40 yd., if strips run lengthwise;
20 ft. $\div$ 3 ft. $= 6\frac{2}{3}$ (7 strips required);
17 ft. $= 5\frac{2}{3}$ yd., length of carpet;
$5\frac{2}{3}$ yd. $\times 7 = 39\frac{2}{3}$ yd., if strips run across.

6. 32 ft. $= 10\frac{2}{3}$ yd.;
$10\frac{2}{3}$ yd. $\div \frac{3}{4}$ yd. $= 14\frac{2}{9}$ (15 strips required);

45 ft. = 15 yd.; 15 yd. + $\frac{1}{4}$ yd. = 15$\frac{1}{4}$ yd.;
15$\frac{1}{4}$ yd. × 15 = 228$\frac{3}{4}$ yd.;
\$1.625 × 228$\frac{3}{4}$ = \$371.718$\frac{3}{4}$, cost.

NOTE.—The loss of carpeting is $\frac{7}{9}$ of a strip.

7. 10 in. + 8 in. = 18 in. = 1$\frac{1}{2}$ ft.;
1$\frac{1}{2}$ ft. × 18 = 27 ft. = 9 yd.;
9 yd. + 1$\frac{1}{4}$ yd. = 10$\frac{1}{4}$ yd., length of carpet;
\$2.25 × 10$\frac{1}{4}$ = \$23.06$\frac{1}{4}$, cost of carpet.

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8. 18$\frac{1}{2}$ ft. × 2 + 16$\frac{3}{4}$ ft. × 2 = 70$\frac{1}{2}$ ft., peri. of room;
70$\frac{1}{2}$ sq. ft. × 10 = 705 sq. ft., in walls;
18$\frac{1}{2}$ sq. ft. × 16$\frac{3}{4}$ = 309$\frac{7}{8}$ sq. ft., in ceiling;
705 sq. ft. + 309$\frac{7}{8}$ sq. ft. = 1014$\frac{7}{8}$ sq. ft. = 112$\frac{55}{72}$ sq. d., surface;
112$\frac{55}{72}$ sq. yd. − 18 sq. yd. = 94$\frac{55}{72}$ sq. yd.;
\$.33$\frac{1}{3}$ × 94$\frac{55}{72}$ = \$31.587+, cost.

9. 25 ft. × 2 + 18 ft. × 2 = 86 ft.;
86 sq. ft. × 12$\frac{1}{2}$ = 1075 sq. ft., in walls;
25 sq. ft. × 18 = 450 sq. ft., in ceiling;
9 sq. ft. × 3$\frac{1}{2}$ × 2 + 7 sq. ft. × 3 × 3 = 126 sq. ft., in doors and windows;
1075 sq. ft. + 450 sq. ft. − 126 sq. ft. = 1399 sq. ft. = 155$\frac{4}{9}$ sq. yd., of plastering;
\$.35 × 155$\frac{4}{9}$ = \$54.405$\frac{5}{9}$, cost.

10. 36 ft. × 2 + 25 ft. × 2 = 122 ft., perimeter room
122 sq. ft. × 14 = 1708 sq. ft., in walls; 10 sq. ft. × 8 + 8 sq. ft. × 3$\frac{1}{2}$ + 8 sq. ft. × 3$\frac{1}{2}$ × 6 + 110$\frac{1}{2}$ sq. ft. × 2$\frac{5}{6}$ = 589$\frac{1}{12}$ sq. ft., in doors, windows, and dado; 1708 sq. ft. − 589$\frac{1}{12}$ sq. ft. = 1118$\frac{11}{12}$ sq. ft. in plastered walls; 36 sq. ft. × 25 = 900 sq. ft., in ceiling; 1118$\frac{11}{12}$ sq. ft. + 900 sq. ft. = 2018$\frac{11}{12}$ sq. ft. = 224$\frac{85}{108}$ sq. yd., of plastering;
224$\frac{85}{108}$ × \$.45 = \$100.94$\frac{7}{12}$, cost of plastering.

11. 25 ft. × 2 + 18 ft. × 2 = 86 ft., perimeter room;
86 sq. ft. × $12\frac{1}{2}$ = 1075 sq. ft., in walls; 9 sq. ft. × $3\frac{1}{2}$ × 2 + 7 sq. ft. × 3 × 3 + 79 sq. ft. × 3 = 363 sq. ft., in doors, windows, and wainscot; 1075 sq. ft. — 363 sq. ft. = 712 sq. ft., in kalsomined walls; 25 sq. ft. × 18 = 450 sq. ft., in ceiling; 712 sq. ft. + 450 sq. ft. = 1162 sq. ft. = $129\frac{1}{9}$ sq. yd., of kalsomining;
$129\frac{1}{9}$ × \$.06 = \$7.74$\frac{2}{3}$, cost of kalsomining.

12. $18\frac{1}{2}$ ft. × 2 + $16\frac{1}{2}$ × 2 = 70 ft.;
70 sq. ft. × 12 = 840 sq. ft. = $93\frac{1}{3}$ sq. yd.;
\$.27 × $93\frac{1}{3}$ = \$25.20, cost.

13. $18\frac{1}{2}$ ft. × 2 + $16\frac{3}{4}$ ft. × 2 = $70\frac{1}{2}$ ft., peri. of room,
$70\frac{1}{2}$ sq. ft. × 10 = 705 sq. ft. = $78\frac{1}{3}$ sq. yd., in walls;
$78\frac{1}{3}$ sq. yd. − 22 sq. yd. = $56\frac{1}{3}$ sq. yd., of paper;
8 sq. yd. × $\frac{1}{2}$ = 4 sq. yd., in roll;
$56\frac{1}{3}$ sq. yd. ÷ 4 sq. yd. = $14\frac{1}{12}$, no. rolls (15 required);
\$.75 × 15 = \$11.25, cost.

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14. 35 ft. × 2 + 27 ft. × 2 = 124 ft., perimeter of room;
124 sq. ft. × 14 = 1736 sq. ft. = $192\frac{8}{9}$ sq. yd., in walls;
$192\frac{8}{9}$ sq. yd. — 25 sq. yd. = $167\frac{8}{9}$ sq. yd., of paper;
$167\frac{8}{9}$ sq. yd. ÷ 4 sq. yd. = $41\frac{35}{36}$ (42 rolls required);
\$.65 × 42 = \$27.30, cost of paper;
\$.05 × (124 ÷ 3) = \$2.06$\frac{2}{3}$, cost of border;
\$27.30 + \$2.06$\frac{2}{3}$ = \$29.36$\frac{2}{3}$, total cost.

15. 16 sq. ft. × $\frac{10}{12}$ = $13\frac{1}{3}$ sq. ft. = $13\frac{1}{3}$ bd. ft.

NOTE.—Lumber 1 inch or less in thickness is measured by surface measure. There is the same number of feet of lumber in a board 1 inch thick and in one $\frac{3}{4}$ inch thick, the length and width being the same.

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16. (8 in. + 5 in.) ÷ 2 = $6\frac{1}{2}$ in., average width of board;
14 sq. ft. × $6\frac{1}{2}$ ÷ 12 = $7\frac{7}{12}$ sq. ft. = $7\frac{7}{12}$ bd. ft.

17. 14 sq. ft. $\times \frac{6}{12} \times 20 = 140$ sq. ft. $= 140$ bd. ft.

18. 12 sq. ft. $\times \frac{8}{12} \times 2 \times 9 = 144$ sq. ft. $= 144$ bd. ft.

19. 14 sq. ft. $\times \frac{4}{12} \times 3 \times 5 = 70$ sq. ft. $= 70$ bd. ft.

20. 16 sq. ft. $\times \frac{10}{12} \times 2\frac{1}{2} \times 10 = 333\frac{1}{3}$ sq. ft. $= 333\frac{1}{3}$ bd. ft.

21. 16 sq. ft. $\times \frac{10}{12} \times 34 = 453\frac{1}{3}$ sq. ft.
12 sq. ft. $\times \frac{8}{12} \times 16 = 128$ " "
14 sq. ft. $\times \frac{4}{12} \times 2 \times 16 = 149\frac{1}{3}$ " "
12 sq. ft. $\times \frac{6}{12} \times 2\frac{1}{2} \times 9 = 135$ " "
14 sq. ft. $\times \frac{5}{12} \times 26 = 151\frac{2}{3}$ " "
$1017\frac{1}{3}$ sq. ft. $= 1.017\frac{1}{3}$ [M. bd. ft.
$\$18 \times 1.017\frac{1}{3} = \$18.312$, cost.

22. 24 sq. ft. $\times \frac{8}{12} \times 6 \times 2 + 30$ sq. ft. $\times \frac{8}{12} \times 6 \times 2 =$ 432 sq. ft. $= .432$ M. bd. ft.;
$\$16 \times .432 = \$6.912$, cost.

23. 21 sq. ft. $\times 16 = 336$ sq. ft., in floor $= .336$ M. bd. ft.;
$\$22 \times .336 = \$7.392$, cost.

24. 40 ft. $\times 2 + 28$ ft. $\times 2 = 136$ ft., length of four sides;
136 sq. ft. $\times 20 = 2720$ sq. ft., in the four sides;
2720 sq. ft. $- 150$ sq. ft. $= 2570$ sq. ft., surface to be ceiled;
5 in. $= \frac{5}{4}$ of 4 in., siding $= \frac{5}{4}$ of surface;
2570 sq. ft. $\times \frac{5}{4} = 3212\frac{1}{2}$ sq. ft. $= 3212\frac{1}{2}$ bd. ft.

25. 50 sq. ft. $\times 22\frac{1}{2} \times 2 = 2250$ sq. ft., in roof;
2250 sq. ft. $\div 125$ sq. ft. $= 18$, no. of M. shingles;
$\$3.25 \times 18 = \$58.50$, cost.

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29. (2) 32 sq. ch. $\times 10.25 = 328$ sq. ch. $= 32.8$ A.

30. 80.6 sq. ch. $\times .9 = 72.54$ sq. ch. $= 7.254$ A.

31. 64 sq. rd. $\times 35\frac{1}{4} = 2256$ sq. rd.;
2256 sq. rd. $\div 160$ sq. rd. $= 14\frac{1}{10}$, no. of acres;
$\$36.50 \times 14.1 = \$514.65$, cost.

32. (2) $2\frac{1}{2}$ mi. $= 800$ rd.; 800 sq. rd. $\times 3\frac{1}{3} = 2666\frac{2}{3}$ sq. rd.;
$2666\frac{2}{3}$ sq. rd. $\div 160$ sq. rd. $= 16\frac{2}{3}$, number of acres.

33. 80 sq. ch. $\times$ 40 = 3200 sq. ch. = 320 A., in farm;
320 A. $\div$ 640 A. = $\frac{320}{640} = \frac{1}{2}$, part of section;
\$22.50 $\times$ 320 = \$7200, cost.

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11. 30 cu. ft. $\times$ 21 $\times$ 6 = 3780 cu. ft. = 140 cu. yd.

12. (1) 15 cu. ft. $\times$ 15 $\times$ 15 = 3375 cu. ft.
(2) 12.5 cu. ft. $\times$ 12.5 $\times$ 12.5 = 1953.125 cu. ft.

13. 65 cu. ft. $\times$ 12 $\times$ 2 $\times$ 2 = 3120 cu. ft., in two side walls;
40 cu. ft. $\times$ 12 $\times$ 2 $\times$ 2 = 1920 cu. ft., in two end walls;
5040 cu. ft., in all the walls.
Or, 65 ft. $\times$ 2 + 40 ft. $\times$ 2 = 210 ft., length of four walls;
210 cu. ft. $\times$ 12 $\times$ 2 = 5040 cu. ft., in four walls.

NOTE 1.—If the side walls are considered 65 feet long, the two end walls must each be considered 4 feet less than the width of the building, since the two side walls are each 2 feet thick, and thus take 2 feet from each end of the end walls.

2. In measuring the walls of cellars and buildings, masons take the distance around the *outside* of the walls (the girth) for the length, thus measuring each corner *twice* (New Comp. Arith., p. 172, note), but in finding the exact number of cubic feet in the walls of a building, as is required in the above problem, each corner should be counted but once.

14. 30 cu. ft. $\times$ $3\frac{1}{2}$ = 105 cu. ft. in 1 ft. high;
840 cu. ft. $\div$ 105 cu. ft. = 8, number of feet high.

15. 45 cu. ft. $\times$ 27 $\times$ $2\frac{1}{3}$ = 2835 cu. ft. in wall;
27 bricks $\times$ 2835 = 76545 bricks.

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17. 2 ft. $\times$ 3.1416 = 6.2832 ft., circumference;
6.2832 sq. ft. $\times$ $\frac{1}{2}$ = 3.1416 sq. ft., area of base;
3.1416 cu. ft. $\times$ 5 = 15.708 cu. ft., solid contents.

18. 5 ft. $\times$ 3.1416 = 15.708 ft. circumference;
15.708 sq. ft. $\times$ $\frac{5}{4}$ = 19.635 sq. ft., area of base;
19.635 cu. ft. $\times$ $8\frac{1}{2}$ = 166.8975 cu. ft., in cistern.

19. (1) 3 ft. $\times$ 3.1416 = 9.4248 ft., circumference;
9.4248 sq. ft. $\times \frac{3}{4}$ = 7.0686 sq. ft., area of base;
7.0686 cu. ft. $\times$ 30 = 212.058 cu. ft., in well.

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1. 36 cu. ft. $\times$ 7 $\times$ 4 = 1008 cu. ft.;
1008 cu. ft. $\div$ 128 cu. ft. = $7\frac{7}{8}$, no. of cords.

2. 23 cu. ft. $\times$ 7 $\times$ 4 = 644 cu. ft.;
28 cu. ft. $\times$ $6\frac{1}{2}$ $\times$ 4 = 728 cu. ft.;
17 cu. ft. $\times$ $7\frac{1}{4}$ $\times$ 8 = 986 cu. ft.;
2358 cu. ft., in the three piles;
2358 cu. ft. $\div$ 128 cu. ft. = $18\frac{7}{8}\frac{7}{4}$, no. of cords.

3. (2) 36 $\times$ 6 = 216; 216 $\div$ 32 = $6\frac{3}{4}$, no. of cords.

NOTE.—The first and second problems may be solved in the same manner. In the second problem, the third pile of wood is equivalent to a pile 34 ft. long and $7\frac{1}{4}$ ft. high, and 4 ft. wide.

4. 20 $\times$ $6\frac{1}{2}$ + 26 $\times$ 8 = 338;
338 $\div$ 32 = $10\frac{9}{1\,6}$, no. of cords.

5. (2) 24 $\times$ 6 = 144; 144 $\div$ 32 = $4\frac{1}{2}$, no. of cords.

6. 3 wd. ft. $\times$ 3 $\times$ 3 = 27 wd. ft.;
27 wd. ft. $\div$ 32 wd. ft. = $\frac{2\,7}{3\,2}$, part of cord;
\$4.80 $\times$ $\frac{2\,7}{3\,2}$ = \$4.05, cost of load.

7. $85\frac{1}{2}$ wd. ft. $\times$ $6\frac{1}{8}$ = $541\frac{1}{2}$ wd. ft.;
$541\frac{1}{2}$ wd. ft. $\div$ 32 wd. ft. = $16\frac{5\,4}{6\,4}$, no. of cords;
\$5.625 $\times$ $16\frac{5\,4}{6\,4}$ = \$95.185+, cost.

8. $16\frac{1}{2}$ ft. $\times$ 36 = 594 ft., length of wall;
594 cu. ft. $\times$ $2\frac{1}{2}$ $\times$ 5 = 7425 cu. ft., in wall;
7425 cu. ft. $\div$ 24.75 cu. ft. = 300, number of perches.

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9. 60 cu. ft. $\times$ 5 $\times$ $1\frac{3}{4}$ = 525 cu. ft., in pile;
525 $\div$ $24\frac{3}{4}$ = $21\frac{7}{3\,3}$, or 21.21+, no. perches.

10. 45 ft. $\times$ 2 + 34 ft. $\times$ 2 = 158 ft., in girth;
158 cu. ft. $\times$ 8 $\times$ $2\frac{1}{8}$ = $2738\frac{3}{8}$ cu. ft.;
$2738\frac{3}{8}$ cu. ft. $\div$ $24\frac{3}{4}$ cu. ft. = 110.653+, no. perches.

NOTE.—See note 2, page 37.

11. 48 cu. ft. $\times$ $2\frac{1}{2}$ $\times$ 7 $\times$ 2 = 1680 cu. ft.;
32 cu. ft. $\times$ $2\frac{1}{2}$ $\times$ 7 $\times$ 2 = 1120 cu. ft.:
1680 cu. ft. + 1120 cu. ft. = 2800 cu. ft., of masonry;
2800 cu. ft. $\div$ 27 cu. ft. = 103.7037+, no. of cu. yd.;
Or, 48 ft. $\times$ 2 + 32 ft. $\times$ 2 = 160 ft., girth;
160 cu. ft. $\times$ $2\frac{1}{2}$ $\times$ 7 = 2800 cu. ft., of masonry;
2800 cu. ft. $\div$ 27 cu. ft. = 103.7037+, no. of cu. yd.

13. 4 cu. ft. $\times$ $2\frac{1}{2}$ $\times$ $2\frac{3}{4}$ = $27\frac{1}{2}$ cu. ft.;
1728 cu. in. $\times$ $27\frac{1}{2}$ = 47520 cu. in.;
47520 cu. in. $\div$ 2150.4 cu. in. = 22.098+, no. of bu.

14. 9 cu. ft. $\times$ $3\frac{1}{3}$ $\times$ $1\frac{1}{4}$ = $37\frac{1}{2}$ cu. ft.;
1728 cu. in. $\times$ $37\frac{1}{2}$ = 64800 cu. in.;
64800 cu. in. $\div$ 2150.4 cu. in. = 30.1339+, no. of bu.
Or, $37\frac{1}{2}$ cu. ft. $\div$ $\frac{5}{4}$ cu. ft. = $37\frac{1}{2}$ $\times$ $\frac{4}{5}$ = 30, no. of bu. by common measure.

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16. 144 cu. in. $\times$ 40 $\times$ 20 = 115200 cu. in.;
115200 cu. in. $\div$ 231 cu. in. = 498.701+, no. of gallons;
498.701 gal. $\div$ 31.5 gal. = 15.831+, no. of barrels.

17. 60 cu. in. $\times$ 60 $\times$ 20 = 72000 cu. in., in vat;
72000 cu. in. $\div$ 231 cu. in. = 311.688+, no. of gal.;
311.688 gal. $\div$ 31.5 gal. = 9.894+, no. of barrels.

18. 60 in. $\times$ 3.1416 = 188.496 in., circumference;
188.496 sq. in. $\times$ 15 = 2827.44 sq. in., area of base;
2827.44 cu. in. $\times$ 96 = 271434.24 cu. in., solid con.;
271434.24 cu. in. $\div$ 231 cu. in. = 1175.04, no. of gal.

NOTE.—The solid contents may be found in cubic feet and this result reduced to cubic inches.

19. 4 ft. $\times$ 3.1416 = 12.5664 ft., circumference;
12.5664 sq. ft. $\times$ 1 = 12.5664 sq. ft., area;
12.5664 cu. ft. $\times$ 10 = 125.664 cu. ft., in cistern;
1728 cu. in. $\times$ 125.664 = 217147.392 cu. in.;
217147.392 cu. in. $\div$ 231 cu. in. = 940.032, no. gal.;
940.032 gal. $\div$ 31.5 gal. = 29.842+, no. of barrels.

20. 15 in. $\times$ 3.1416 = 47.124 in., circumference;
47.124 sq. in. $\times \frac{15}{4}$ = 176.715 sq. in., area;
176.715 cu. in. $\times$ 28 = 4948.02 cu. in., contents;
4948.02 cu. in. $\div$ 231 cu. in. = 21.42, no. of gal.

21. 16 in. $\times$ 3.1416 = 50.2656 in., circumference;
50.2656 sq. in. $\times$ 4 = 201.0624 sq. in., area;
201.0624 cu. in. $\times$ 27 = 5428.6848 cu. in., contents;
5428.6848 cu. in. $\div$ 231 cu. in. = 23.5008, no. of gal.

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22. (1) 62.5 lb. $\div$ 7.5 = $8\frac{1}{3}$ lb., weight of gal. of water.
(2) $8\frac{1}{3}$ lb. $\times$ 1.03 = $8.58\frac{1}{3}$ lb., weight of gal. of milk.

23. (1) 62.5 lb. $\times$.92 = 57.5 lb., of ice.
(2) 62.5 lb. $\times$ 2.65 = 165.625, or $165\frac{5}{8}$ lb., of rock.

24. 1 cu. in. $\times$ 120 = 120 cu. in.;
120 $\div$ 1728 = $\frac{5}{72}$, part of cu. ft.;
62.5 lb. $\times \frac{5}{72}$ = $4.34\frac{1}{36}$ lb., of water;
$4.34\frac{1}{36}$ lb. $\times$ 7.6 = $32.986\frac{1}{3}$ lb., weight of bar.

25. 8 cu. in. $\times$ 4 $\times$ 2 = 64 cu. in.;
64 $\div$ 1728 = $\frac{1}{27}$, part of cu. ft.;
62.5 lb. $\times \frac{1}{27} \times$ 10.5 = 24.305+ lb., weight of brick.

26. 1^{l} of water weighs 1^{Kg}; 25^{l} water, 25^{Kg};
$25^{Kg} \times 1.03 = 25.75^{Kg}$, weight of 25^{l} of pure milk.
Since 25.5^{Kg} is less than 25.75^{Kg}, the milk is not pure.

2. 160 sq. rd. $\times$ 40 = 6400 sq. rd., in park;
6400 sq. rd. $\div$ 50 sq. rd. = 128, no. of rods long.

3. 165 yd. $\div$ $5\frac{1}{2}$ yd. = 30, number of rods in diameter;
30 rd. $\times$ 3.1416 = 94.248 rd., circumference;
94.248 sq. rd. $\times \frac{30}{4}$ = 706.86 sq. rd., area of park;
706.86 sq. rd. $\div$ 160 sq. rd. = $4.417\frac{7}{8}$, no. of acres.

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4. 60 sq. ft. $\times$ $12\frac{3}{4}$ = 765 sq. ft. = 110160 sq. in.;
8 sq. in. $\times$ 4 = 32 sq. in., area of brick;
110160 sq. in. $\div$ 32 sq. in. = $3442\frac{1}{2}$, no. of bricks.
Or, 144 sq. in. $\div$ 32 sq. in. = $4\frac{1}{2}$, no. of bricks to 1 sq. ft.;
$4\frac{1}{2}$ bricks $\times$ 765 = $3442\frac{1}{2}$ bricks.

5. $20\frac{1}{3}$ ft. = $6\frac{7}{9}$ yd.;
$6\frac{7}{9}$ yd. $\div$ $\frac{8}{4}$ yd. = $9\frac{1}{27}$, no. strips (9 required);
27 ft. + $\frac{1}{2}$ ft. = $27\frac{1}{2}$ ft. = $9\frac{1}{6}$ yd., length of carpet;
$9\frac{1}{6}$ yd. $\times$ 9 = $82\frac{1}{2}$ yd., of carpeting.

NOTE.—Since carpeting will stretch a little in laying, 9 strips will cover the floor, and the $\frac{1}{27}$ of a strip (1 inch) may be disregarded.

6. 15 ft. = 5 yd.;
5 yd. $\div$ $\frac{3}{4}$ yd. = $6\frac{2}{3}$, no. strips (7 required);
$18\frac{1}{3}$ ft. + $\frac{2}{3}$ ft. = 19 ft. = $6\frac{1}{3}$ yd., length of carpet;
$6\frac{1}{3}$ yd. $\times$ 7 = $44\frac{1}{3}$ yd., of carpeting.

7. 15 ft. = 5 yd.; 12 ft. = 4 yd.; 9 ft. = 3 yd.;
5 yd. $\times$ 2 + 4 yd. $\times$ 2 = 18 yd., perimeter;
18 sq. yd. $\times$ 3 = 54 sq. yd., in walls;
5 sq. yd. $\times$ 4 = 20 sq. yd., in ceiling;
54 sq. yd. + 20 sq. yd. — 15 sq. yd. = 59 sq. yd;
\$.50 $\times$ 59 = \$29.50, cost of plastering.

8. 8 cu. ft. $\times$ $3\frac{1}{2}$ $\times$ 4 = 112 cu. ft. = 193536 cu. in.;
193536 cu. in. $\div$ 2150.4 cu. in. = 90, no. of bushels.

9. $3\frac{1}{3}$ ft. $\times$ 3.1416 = 10.472 ft., circumference;
10.472 sq. ft. $\times$ $\frac{5}{6}$ [$\frac{1}{4}$ of $3\frac{1}{3}$] = $8.72\frac{2}{3}$ sq. ft., in base;
$8.72\frac{2}{3}$ cu. ft. $\times$ 20 = $174.5\frac{1}{3}$ cu. ft., in well.

10. 5 ft. $\times$ 3.1416 = 15.708 ft., in circumference;
15.708 sq. ft. $\times$ $\frac{5}{4}$ = 19.635 sq. ft., area of base;
19.635 cu. ft. $\times$ $6\frac{1}{3}$ = 124.355 cu. ft., in cistern;
1728 cu. in. $\times$ 124.355 = 214885.44 cu. in., in cistern;
214885.44 cu. in. $\div$ 231 cu. in. = 930.24 gal., capacity of cistern.

11. 3 ft. $\times$ 3.1416 = 9.4248 ft., circumference;
9.4248 sq. ft. $\times \frac{3}{4}$ = 7.0686 sq. ft., area of base;
7.0686 cu. ft. $\times$ 10 = 70.686 cu. ft., contents;
1728 cu. in. $\times$ 70.686 = 122145.408 cu. in.;
122145.408 cu. in. $\div$ 231 cu. in. = 528.768 gal.;
528.768 gal. $\div$ 31.5 gal. = 16.786+ no. of barrels.

12. 12 cu. in. $\times$ 12 $\times$ 12 = 1728 cu. in.;
2 cu. in. $\times$ 2 $\times$ 2 = 8 cu. in.;
1728 cu. in. $\div$ 8 cu. in. = 216, number of blocks.

NOTE.—If the edge of the box (12 in.) were not a multiple of the edge of the block (2 in.), a different solution would be required.

13. $10.5^{\text{cu. m}} \times 7.6 \times 1.8 = 143.64^{\text{cu. m}}$, in cellar;
\$.25 $\times$ 143.64 = \$35.91, cost.

14. $8.5^{\text{m}} \times 2 + 6.4^{\text{m}} \times 2 = 29.8^{\text{m}}$, perimeter of room;
$29.8^{\text{sq. m}} \times 3.8 = 113.24^{\text{sq. m}}$, in walls;
$8.5^{\text{sq. m}} \times 6.4 = 54.4^{\text{sq. m}}$, in ceiling;
$113.24^{\text{sq. m}} + 54.4^{\text{sq. m}} - 10^{\text{sq. m}} = 157.64^{\text{sq. m}}$;
\$.45 $\times$ 157.64 = \$70.938, cost of plastering.

15. $5.5^{\text{m}} \times 3.1416 = 17.2788^{\text{m}}$, circumference;
$17.2788^{\text{sq. m}} \times \frac{5.5}{4} = 23.75835^{\text{sq. m}}$, area of base;
$23.75835^{\text{cu. m}} \times 3.25 = 77.21463^{\text{cu. m}}$.

16. (1) $25^{\text{cu. dm}} \times 25 \times 25 = 15625^{\text{cu. dm}}$;
$1^{\text{l}} \times 15625 = 15625^{\text{l}} = 156.25^{\text{Hl}}$.
(2) $1^{\text{l}} = 1.0567$ qt. $= .2641\frac{3}{4}$ gal.;
$.2641\frac{3}{4}$ gal. $\times$ 15625 = $4127.7343\frac{3}{4}$ gal.

PERCENTAGE.

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25. (1) $\frac{5}{8} \times \frac{15}{100} = \frac{3}{32}$. Or, $\frac{5}{8} \times .15 = .09\frac{3}{8}$
(2) $\frac{9}{10} \times \frac{15}{100} = \frac{27}{200}$. Or, $.9 \times .15 = .135$

26. (1) $66\frac{2}{3}\% = \frac{2}{3}$; $\frac{7}{15} \times \frac{2}{3} = \frac{14}{45}$. Or, $\frac{7}{15} \times .66\frac{2}{3} = .31\frac{1}{9}$
(2) $\frac{8}{8} \times \frac{2}{3} = \frac{16}{9} = 1\frac{7}{9}$. Or, $2\frac{2}{3} \times .66\frac{2}{3} = 1.77\frac{7}{9}$.
27. (1) $.25 \times .12 = .03$. (2) $.45 \times .12 = .054$
28. (1) $50 \times .06\frac{1}{4} = 3.125$. (2) $.75 \times .06\frac{1}{4} = .046875$
29. 480 mi. $\times$.33 = 158.4 mi.;
480 mi. $\times .25\frac{1}{2} = 122.4$ mi.;
158.4 mi. $-$ 122.4 mi. = 36 mi.
Or, $.33 - .25\frac{1}{2} = .07\frac{1}{2}$; 480 mi. $\times .07\frac{1}{2} = 36$ mi.
30. 3740 lb. $\times .70 = 2618$ lb., of iron.
31. $143\frac{3}{4}$ tons $\times .20 = 28\frac{3}{4}$ tons, of water.

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20. $\frac{1}{3} \div \frac{5}{6} = \frac{6}{15} = \frac{2}{5} = .40$, or 40%.
21. $\frac{2}{3} \div \frac{4}{5} = \frac{10}{12} = \frac{5}{6} = .83\frac{1}{3}$, or $83\frac{1}{3}\%$.
22. $\frac{3}{4} \div 2\frac{1}{2} = \frac{3}{4} \times \frac{2}{5} = \frac{3}{10} = .30$, or 30%.
23. 48 sheep $\div$ 320 sheep $= \frac{48}{320} = .15$, or 15%.
24. (2) $16 \div 24 = \frac{16}{24} = \frac{2}{3} = .66\frac{2}{3}$, or $66\frac{2}{3}\%$.

NOTE.—An alloy of gold is said to be as many carats fine as it contains twenty-fourths of gold; and hence, in this example, $\frac{18}{24}$ of the ring is gold.

25. \$150 $\times .16\frac{2}{3} =$ \$25; \$25 $\div$ \$45 $= .55\frac{5}{9} = 55\frac{5}{9}\%$.
Or, $16\frac{2}{3}\% = \frac{1}{6}$; \$150 $\times \frac{1}{6} =$ \$25; \$25 $\div$ \$45 $= .55\frac{5}{9}$.

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35. $100\% - 12\frac{1}{2}\% = 87\frac{1}{2}\%$; \$34.50 $\div .87\frac{1}{2} =$ \$39.42$\frac{6}{7}$.
Or, $12\frac{1}{2}\% = \frac{1}{8}$; $\frac{8}{8} - \frac{1}{8} = \frac{7}{8}$; \$34.50 $\div \frac{7}{8} =$ \$39.42$\frac{6}{7}$.
36. $100\% - 3\frac{1}{3}\% = 96\frac{2}{3}\%$; \$44.60 $\div .96\frac{2}{3} =$ \$46.137+.
Or, $3\frac{1}{3}\% = \frac{1}{30}$; $\frac{30}{30} - \frac{1}{30} = \frac{29}{30}$; $44.60 \div \frac{29}{30} =$ \$46.13$\frac{23}{29}$.
37. $100\% - 6\% = 94\%$; $470 \div .94 = 500$.
38. $100\% + 30\% = 130\%$; $162.5 \div 1.30 = 125$.
39. $100\% - 16\frac{2}{3}\% = 83\frac{1}{3}\%$; $2035.8 \div .83\frac{1}{3} = 2430$.

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13. $33\frac{1}{3}\%$ of a number is $\frac{1}{3}$ of it; $\frac{1}{3}$ of 240 is 80; if 80 is $\frac{1}{3}$ less than a number, it is $\frac{2}{3}$ of it; if 80 is $\frac{2}{3}$ of a number $\frac{1}{3}$ of it is 40, and $\frac{3}{3}$, or the number, is 120.

14. 25%, or $\frac{1}{4}$, of 280 is 70; if 70 is $16\frac{2}{3}\%$, or $\frac{1}{6}$, more than a number, 70 is $\frac{7}{6}$ of it; if 70 is $\frac{7}{6}$ of a number, 10 is $\frac{1}{6}$ of it, and $\frac{6}{6}$, or the number, is 60.

15. (1) $\frac{3}{5}$ of a number is $\frac{3}{5}$ of 100% of it; $\frac{1}{5}$ of 100% is 20%, and $\frac{3}{5}$ is 3 times 20%, which is 60%.

16. $\frac{4}{15}$ of a number is $\frac{4}{15}$ of 100% of it; $\frac{4}{15}$ of 100% is $\frac{1}{15}$ of 400%, which is $26\frac{2}{3}\%$.

17. (2) $\frac{3}{25}$ of a number is $\frac{3}{25}$ of 100% of it; $\frac{3}{25}$ of 100% is $\frac{1}{25}$ of 300%, which is 12%.

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19. 20%, or $\frac{1}{5}$, of 60 years is 12 years; if 12 years are 25%, or $\frac{1}{4}$, of the wife's age, her age is 4 times 12 years, which is 48 years.

20. 75 men less 25 men are 50 men; 50 men are $\frac{50}{75}$, or $\frac{2}{3}$ of 75 men; $\frac{2}{3}$ equals $66\frac{2}{3}$ hundredths, or $66\frac{2}{3}\%$.

21. If 15 years is 30% of the father's age, 1% is $\frac{1}{30}$ of 15 years, or $\frac{1}{2}$ year, and 100% is 100 times $\frac{1}{2}$ year, which is 50 years: the father's age was 50 years.

22. If \$28 is 70% of his wages, 1% is $\frac{1}{70}$ of \$28, which is $\$\frac{2}{5}$, and 100% is 100 times $\$\frac{2}{5}$, which is \$40.

23. If 24% of the pupils are 96 pupils, 1% is $\frac{1}{24}$ of 96 pupils, which is 4 pupils, and 100% is 100 times 4 pupils, which is 400 pupils.

24. If \$160 is 20%, or $\frac{1}{5}$, less than the cost of the carriage, \$160 is $\frac{4}{5}$ of the cost of the carriage; if \$160 is $\frac{4}{5}$ of the cost, $\frac{1}{5}$ is \$40, and $\frac{5}{5}$, or the cost, is \$200.

25. If 230 is 15% more than the number of girls, 230 is 115% of the number of girls; if 230 is 115%, 1% is 2 and 100% is 200, the number of girls; and 230 plus 200, or 430, is the number of pupils.

26. $100\% - 87\frac{1}{2}\% = 12\frac{1}{2}\%$; $\$1650 \times .12\frac{1}{2} = \$206.25$.
Or, $12\frac{1}{2}\% = \frac{1}{8}$; $\$1650 \times \frac{1}{8} = \$206.25$.
27. 750 men $-$ 160 men $=$ 590 men;
$590 \div 750 = .78\frac{2}{3} = 78\frac{2}{3}\%$.
28. $420 \div .80 = 525$, number of pupils enrolled.
29. $5220 \div .36 = 14500$, population of city.
30. $60\% + 25\% = 85\%$; $100\% - 85\% = 15\%$, left;
$\$7.50 \div .15 = \$50$, money at first.
31. $\$5400 \div .375 = \$14400$, value of property.
Or, $37\frac{1}{2}\% = \frac{3}{8}$; $\$5400 \div \frac{3}{8} = \$14400$.
32. $250 \div .40 = 625$, number of barrels at first;
625 bbl. $-$ 250 bbl. $=$ 375 bbl., left.

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33. 40% of $60\% = .60 \times .40 = .24$;
$\$9600 \div .24 = \$40000$, value of factory.
Or, $40\% = \frac{2}{5}$; $60\% = \frac{3}{5}$; $\frac{2}{5}$ of $\frac{3}{5} = \frac{6}{25}$;
$\$9600 \times \frac{6}{25} = \$40000$, value.
34. 50000000 sq. mi. $\div .33\frac{1}{3} = 150000000$ sq. mi., water [surface.
Or, 50000000 sq. mi. $\div \frac{1}{3} = 150000000$ sq. mi.
35. $64000 \div .80 = 80000$, population.
36. $100\% + 12\frac{1}{2} = 112\frac{1}{2}\%$; $\$6390 \div 1.125 = \$5680$, cost.
37. 58500 bu. $\times .37\frac{1}{2} = 21937.5$ bu., by steamer;
58500 bu. $\times .33\frac{1}{3} = 19500$ bu., by schooner;
21937.5 bu. $+$ 19500 bu. $=$ 41437.5, by st. and sch.;
58500 bu. $-$ 41437.5 bu. $=$ 17062.5 bu., by rail.
Or, $37\frac{1}{2}\% + 33\frac{1}{3}\% = 70\frac{5}{6}\%$;
$100\% - 70\frac{5}{6}\% = 29\frac{1}{6}\%$, part by rail;
58500 bu. $\times .29\frac{1}{6} = 17062.5$ bu., by rail.
38. $100\% + 17\frac{1}{5}\% = 117\frac{1}{5}\% = 1.172$;
$63500 \times 1.172 = 74422$, population.
39. $100\% - 32\% = 68\%$, or .68;
306 acres $\div .68 = 450$ acres, B's farm.
40. $100\% + 25\% = 125\%$, or 1.25;
$\$150 \div 1.25 = \$120$, gold value.
Or, $25\% = \frac{1}{4}$; $1 + \frac{1}{4} = \frac{5}{4}$; $\$150 \div \frac{5}{4} = \$120$.

41. $100\% + 20\% = 120\% = 1.20$; $\$1 \div 1.20 = \$.83\frac{1}{3}$.

42. $100\% - 5\% = 95\%$, or .95;
$570 \div .95 = 600$, number of pupils.

43. $100\% + 15\% = 115\%$, or 1.15;
$920 \div 1.15 = 800$, number of pupils.

44. $100\% + 18\% = 118\%$, or 1.18;
$171572 \div 1.18 = 145400$, population.

45. 480 A. $\times .30 = 144$ A., meadow;
480 A. $\times .25\frac{1}{2} = 122.4$ A., pasture;
480 A. $\times .16\frac{2}{3} = 80$ A., grain land;
144 A. + 122.4 A. + 80 A. = 346.4 A.;
480 A. − 346.4 A. = 133.6 A., woodland.

Or, $30\% + 25\frac{1}{2}\% + 16\frac{2}{3}\% = 72\frac{1}{6}\%$;
$100\% - 72\frac{1}{6}\% = 27\frac{5}{6}\%$, or $.27\frac{5}{6}$;
480 A. $\times .27\frac{5}{6} = 133.6$ A., woodland.

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46. $\$6300 \div \$10500 = .60$, or 60%.

47. $\$275 + \$180 + \$150 = \$605$, expenses;
$\$950 - \$605 = \$345$, amount left.
$\$345 \div \$950 = .36\frac{6}{19}$, or $36\frac{6}{19}\%$, per cent left.

48. $\$280 + \$175 = \$455$, amount spent;
$100\% - 35\% = 65\%$, per cent spent;
$\$455 \div .65 = \$700$, income.

49. $\$27000 \times .10 = \$2700$;
$\$2700 \div .33\frac{1}{3} = \$8100$, income;
$\$8100 \times .80 = \$6480$, expenses.

50. $100\% + 13\frac{4}{5}\% = 113\frac{4}{5}\%$, or 1.138;
$\$10811 \div 1.138 = \$9500$, cost of goods.

51. $100\% - 33\frac{1}{3}\% = 66\frac{2}{3}\%$; $\$9450 \div .66\frac{2}{3} = \$14175$.

52. $1200 \times .45 = 540$, number of apple trees;
$1200 \times .22 = 264$, number of peach trees;
$1200 \times .12\frac{1}{2} = 150$, number of cherry trees;
$1200 - (540 + 264 + 150) = 246$, no. of pear trees.

Or, $45\% + 22\% + 12\frac{1}{2}\% = 79\frac{1}{2}\%$;
$100\% - 79\frac{1}{2}\% = 20\frac{1}{2}\%$;
$1200 \times .20\frac{1}{2} = 246$, number of pear trees.

53. $\$35000 \times .42\frac{1}{2} = \$14875$, A's share;
$\$35000 \times .37 = \$12950$, B's share;
$\$35000 - (\$14875 + \$12950) = \$7175$, C's share.

Or, $100\% - (42\frac{1}{2}\% + 37\%) = 20\frac{1}{2}\%$;
$\$35000 \times .20\frac{1}{2} = \$7175$, C's share.

54. $\$7560 \div .625 = \$12096$, children's share;
$\$7560 + \$12096 = \$19656$, wife's and ch.'s shares;
$\$19656 \div .80 = \$24570$, estate.

(2) $\$7560 \div \$24570 = 30\frac{9}{13}\%$, wife's per cent of estate.

55. $41064 \div 1.16 = 35400$, population in 1870;
$35400 \div .93\frac{3}{4} = 37760$, population in 1875.

56. $1950 \div .03\frac{1}{4} = 60000$, population.

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8. He gains 30 cts. a pound on each kind; and 30 cts. is $\frac{1}{4}$, or 25%, of \$1.20, and $\frac{3}{14}$, or $21\frac{3}{7}\%$, of \$1.40, and $\frac{1}{5}$, or 20%, of \$1.50; hence he gains 25% on the first, $21\frac{3}{7}\%$ on the second, and 20% on the third.

9. If \$2 is 20%, or $\frac{1}{5}$, of the cost, the cost was 5 times \$2, which is \$10.

10. If \$1.50 is $33\frac{1}{3}\%$, or $\frac{1}{3}$, of the cost, the cost was 3 times \$1.50, which is \$4.50.

11. If 20 cts. is $16\frac{2}{3}\%$, or $\frac{1}{6}$, of the cost of the tea, the cost was 6 times 20 cts., which is \$1.20; and the selling price was \$1.20 plus \$.20, which is \$1.40.

12. If he gained 20%, or $\frac{1}{5}$, \$90 is $\frac{5}{6}$ of the cost; if \$90 is $\frac{5}{6}$, \$15 is $\frac{1}{6}$, and \$75 is the cost.

13. If he lost 20%, or $\frac{1}{5}$, \$80 is $\frac{4}{5}$ of the cost; if \$80 is $\frac{4}{5}$, \$20 is $\frac{1}{5}$, and \$100 is the cost.

14. If 25%, or $\frac{1}{4}$, is gained, 40 cts. is $\frac{5}{4}$ of the cost; if 40 cts. is $\frac{5}{4}$ of cost, 8 cts. is $\frac{1}{4}$, and 32 cts. is the cost.

15. 10%, or $\frac{1}{10}$ of \$80, is \$8; \$80 less \$8 is \$72, the selling price.

16. (1) To gain 25%, the selling price must be 25%, or $\frac{1}{4}$, more than the cost, which is $\frac{5}{4}$ of the cost; $\frac{5}{4}$ of \$2 is \$2.50; $\frac{5}{4}$ of \$2.50 is \$3.12$\frac{1}{2}$; $\frac{5}{4}$ of \$3 is \$3.75.

(2) To gain 30%, the selling prices must be 30%, or $\frac{3}{10}$, more than the cost, which is $\frac{13}{10}$ of the cost; $\frac{13}{10}$ of \$2 is \$2.60; $\frac{13}{10}$ of \$2.50 is \$3.25; $\frac{13}{10}$ of \$3 is \$3.90.

17. To gain 25%, or $\frac{1}{4}$, the muslin must be sold at $\frac{5}{4}$ of the cost; $\frac{5}{4}$ of 10 cts. is 12$\frac{1}{2}$ cts.; $\frac{5}{4}$ of 15 cts. is 18$\frac{3}{4}$ cts.; $\frac{5}{4}$ of 18 cts. is 22$\frac{1}{2}$ cts.

18. If 20%, or $\frac{1}{5}$, is gained, 90 cts. is $\frac{4}{5}$ of the cost; if 90 cts. is $\frac{4}{5}$ of the cost, $\frac{1}{5}$ is 15 cts., and $\frac{5}{5}$ is 75 cts.; if sold for \$1.00, the gain would have been 25 cents, which is $\frac{1}{3}$, or 33$\frac{1}{3}$%, of 75 cents.

19. If the retail price is 30% more than the cost, it is 130% of the cost; if the wholesale price is 10%, or $\frac{1}{10}$, less than the retail price, it is $\frac{9}{10}$ of the retail price, which is $\frac{9}{10}$ of 130% of the cost, or 117% of the cost; hence the wholesale price is 17% more than the cost.

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20. If the marked price was 25% more than cost, it was 125% of the cost; and if the silk was sold at 20%, or $\frac{1}{5}$, less than the market price, it was sold for $\frac{4}{5}$ of 125% of the cost, which is 100% of the cost, and hence the silk was sold at cost, and there was neither gain nor loss.

21. Since 5 is not any per cent of 0, the \$5 gained was not *any per cent* of the cost, which was 0. For the same reason, the \$10 gained was not any per cent of the cost, or 0.

22. Since 100% of the cost equals the cost, 100% less than cost would be 0, or nothing, and hence an article can not be *sold* at a loss of 100%, as there would be no

selling price. Since more than 100% of the cost would be more than the cost, an article can not be sold at a loss of more than 100%.

(2) An article can be sold at more than 100%, since any per cent of a number can be added to it.

23. \$6750 × 1.12½ = \$7593.75, selling price.
Or, 12½% = ⅛; \$6750 × ⅛ = \$7593.75.

24. \$165 × .18 = \$29.70, gain.

25. \$5400 — \$4500 = \$900, gain;
\$900 ÷ \$4500 = .20, or 20%, gain per cent.

26. \$84.50 — \$65. = \$19.50, gain per head;
\$19.50 ÷ \$65 = .30, or 30%, gain per cent.

27. \$130 + \$6 = \$136, cost per head;
\$153.50 — \$136 = \$17.50, gain per head;
\$17.50 ÷ \$136 = .12$\frac{5}{8}$, or 12$\frac{5}{8}$%, gain per cent.

28. \$16500 — \$13750 = \$2750, loss;
\$2750 ÷ \$16500 = .16⅔, or 16⅔%, loss per cent.

29. \$8160 ÷ 12½ = \$65280, cost.
Or, \$8160 ÷ ⅛ = \$65280.

30. \$45.10 ÷ .22 = \$205, cost;
\$205 ÷ 82 = \$2.50, cost per barrel.

31. \$180 ÷ .83⅓ = \$216, cost of watch.

32. \$7762.50 ÷ 1.15 = \$6750, cost.

33. ⅖ + ½ = $\frac{9}{10}$;
$\frac{10}{10} - \frac{9}{10} = \frac{1}{10}$, part of sales at 33⅓% profit;
\$45000 × ⅖ = \$18000;
\$45000 × ½ = \$22500; \$45000 × $\frac{1}{10}$ = \$4500;
\$18000 ÷ 1.20 = \$15000, cost of ⅖ of goods;
\$22500 ÷ 1.25 = \$18000, cost of ½ of goods;
\$4500 ÷ 1.33⅓ = \$ 3375, cost of $\frac{1}{10}$ of goods;
\$36375, total cost of goods.

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34. \$240 ÷ .80 = \$300, cost price;
\$300 × 1.20 = \$360, selling price at 20% gain.

35. $3.50 \times 1.15 = \$4.025$, selling price at 15% gain;
$\$4.025 \div .85 = \$4.735+$, marked price.

36. (1) $100\% + 20\% = 120\%$; $120\% \times 1.10 = 132\%$.
(2) $\$5780.50 \div 1.32 = \$4379.16\frac{2}{3}$, cost;
$\$5780.50 - \$4379.16\frac{2}{3} = \$1401.33\frac{1}{3}$, gain.

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7. Since \$40 was 5% of the property sold, 1% of it was \$8, and 100%, or the property, was \$800.

8. Since \$60 was 10% of the amount collected, 1% was \$6, and 100% was \$600.

9. The \$108 received was the sum to be expended for peaches plus 8% of it, and hence \$108 was 108% of the sum paid for peaches; if \$108 was 108%, 1% was \$1, and 100% was \$100, the sum paid for peaches.

10. 100% plus 3% is 103%, and hence \$309 is 103%, of the sum to be expended for flour; if \$309 was 103%, 1% was \$3, and 100% was \$300, the sum paid for flour.

11. $\$6.37\frac{1}{2} \times 540 = \$3442.50$, sale receipts;
$\$3442.50 \times .03 = \$103.275$, commission.

12. $\$24.50 \times 325 = \$7962.50$, sale receipts;
$\$7962.50 \times .025 = \$199.06\frac{1}{4}$, commission.

13. $\$5160.50 + \$715.25 = \$5875.75$, amount sold;
$\$5875.75 \times .015 = \$88.136+$, commission.

14. $\$950 \times .65 = \$617.50$, amount collected;
$\$617.50 \times .06\frac{1}{4} = \$38.59375$, commission;
$\$617.50 - \$38.59375 = \$578.90625$, am't paid over.

15. $\$75000 \times .01\frac{3}{4} = \$1312.50$, commission;
$\$75000 + \$1312.50 = \$76312.50$, cost of cotton and commission.

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16. $\frac{1}{4}\% + 1\frac{3}{8}\% = 1\frac{5}{8}\%$, total fee per cent;
$\$120000 \times .01\frac{5}{8} = \$1950$, fees.

17. $\$540 \div \$4500 = .12$, or 12%, rate of commission.

18. $\$75 \div \$1125 = .06\frac{2}{3}$, or $6\frac{2}{3}\%$, rate of commission.

19. $\$750 \div .025 = \$30000$, amount of purchase.

20. $\$208.50 \div .05 = \$4170$, amount of purchase.

21. $\$1.75 \times 3300 = \$5775$, cost of apples;
$\$5775 \times .03 = \$173.25$, commission;
$\$5775 + \$173.25 = \$5948.25$, remittance.

22. $\$3529.20 \div 1.02 = \$3460$, amount paid for bacon;
$\$3529.20 - \$3460 = \$69.20$, commission.

23. $\$11774 \div 1.015 = \$11600$, amount paid for cotton;
$\$11774 - \$11600 = \$174$, commission.

24. $\$7.50 \times 640 = \$4800$, sale receipts;
$\$4800 \times .01\frac{1}{2} = \$72$, commission for selling land;
$\$4800 - \$72 = \$4728$, net proceeds of land sale;
$\$4728 \div 1.00\frac{7}{8} = \$4686.9888+$, am't inv. in stock;
$\$4728 - \$4686.9888+ = \$41.0111$, com. on stock;
$\$72 + \$41.011+ = \$113.011+$, total commission.

25. $\$1.75 \times 750 = \$1312.50$, first cost;
$\$1312.50 \times .02\frac{1}{4} = \$29.531\frac{1}{4}$, commission;
$\$1312.50 + \$29.531\frac{1}{4} = \$1342.031\frac{1}{4}$, face of draft;
$\$1342.031\frac{1}{4} \times .00\frac{1}{4} = \$3.355+$, cost of draft;
$\$1342.031\frac{1}{4} + \$3.355 + \$12.50 = \$1357.886+$, t'l cost.

NOTE.—Freight is paid at place of delivery of goods, and hence the $12.50 is not to be included in the draft.

26. $\$5000 \div 1.025 = \$4878.0487+$, wheat investment;
$\$4878.0487+ \div \$1.10 = 4434.589+$, no. of bushels.

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8. The par value of 10 shares, $100 each, is $1000, and their cost at 104% will be $1040; at 85%, $850; at 90%, $900.

9. 15 shares of $100 each equal $1500; 3% of $1500 is $\frac{3}{100}$ of $1500, which is $45.

10. 20 shares, of $100 each, equal $2000; 5% of $2000 is $\frac{5}{100}$ of $2000, which is $100.

11. $100\% - 7\frac{1}{2}\% = 92\frac{1}{2}\%$;
$\$7500 \times .92\frac{1}{2} = \$6937.50$, cost.

12. $100\% + 6\frac{1}{2}\% = 106\frac{1}{2}\%$; $100\% - \frac{3}{4}\% = 99\frac{1}{4}\%$;
$\$7000 \times 1.06\frac{1}{2} = \$7455$, cost;
$\$7000 \times .99\frac{1}{4} = \$6947.50$, sale receipts;
$\$7455 - \$6947.50 = \$507.50$, loss.

Or, $6\frac{1}{2}\% + \frac{3}{4}\% = 7\frac{1}{4}\%$, loss per cent;
$\$7000 \times .07\frac{1}{4} = \$507.50$, loss.

13. $112\frac{1}{2}\% - 109\frac{1}{2}\% = 3\%$, gain per cent;
$\$10000 \times .03 = \$300$, gain.

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14. $\$5200 \times 1.27 = \$6604$, cost;
$\$3600 \times 1.35 = \$4860$; $\$1600 \times 1.37\frac{1}{2} = \$2200$;
$\$4860 + \$2200 = \$7060$, sale receipts;
$\$7060 - \$6604 = \$456$, gain.

Or, $135\% - 127\% = 8\%$; $137\frac{1}{2}\% - 127\% = 10\frac{1}{2}\%$;
$\$3600 \times .08 = \$288$; $\$1600 \times .10\frac{1}{2} = \$168$;
$\$288 + \$168 = \$456$, gain.

15. $\$50 \times 84 = \$4200$, cost;
$100\frac{3}{7}\% - 94\% = 6\frac{3}{7}\%$, gain per cent;
$\$4200 \times .06\frac{3}{7} = \$270$, gain.

16. (2) $\$840 \div \$105 = 8$, number of shares.

17. $\$8320 \div \$104 = 80$, number of shares.

18. $95\frac{5}{8}\% + \frac{1}{8}\% = 95\frac{3}{4}\%$, cost of stock per cent;
$\$6894 \div .95\frac{3}{4} = \$7200$, amount of stock (72 shares).

19. $100\% - 12\frac{3}{4}\% = 87\frac{1}{4}\%$;
$87\frac{1}{4}\% + \frac{1}{4}\% = 87\frac{1}{2}\%$, cost per cent;
$\$8750 \div \$87.50 = 100$, number of shares.

20. $108\frac{1}{2}\% - 106\% = 2\frac{1}{2}\%$, loss % on stock;
$\$8400 \times .02\frac{1}{2} = \$210$, loss on stock;
$\$8400 \times .05\frac{1}{2} = \$462$, dividend received;
$\$462 - \$210 = \$252$, net gain.

Or, $108\frac{1}{2}\% - 106\% = 2\frac{1}{2}\%$;
$5\frac{1}{2}\% - 2\frac{1}{2}\% = 3\%$, gain per cent;

$8400 \times .03 = \$252$, gain.

21. $4\% + 5\% = 9\%$, gain per cent;
$\$100 \times .09 = \$9$, gain per share;
$\$450 \div \$9 = 50$, number of shares.

22. $124\% - 120\% = 4\%$; $4\% \div 120\% = .03\frac{1}{3}$, or $3\frac{1}{3}\%$.
Or, $\$124 - \$120 = \$4$; $\$4 \div \$120 = .03\frac{1}{3}$, or $3\frac{1}{3}\%$.

23. $\$3600 \times .16\frac{1}{4} = \$585$, dividend received.

24. $\$125000 \times .04 = \$5000$, dividend;
$\$5000 + \$3500 = \$8500$, net earnings.

25. $\$500000 \times .04\frac{2}{5} = \$22000$, dividend distributed;
$22000 + \$2500 = \$24500$, net earnings.

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26. (1) $\$22425 \div \$215000 = .10\frac{37}{86}$, or $10\frac{37}{86}\%$.
(2) $\$4500 \times .10\frac{37}{86} = \$469.36+$

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3. $\frac{2}{3}$ of \$6000 is \$4000, and $1\frac{1}{4}\%$ of \$4000 is 1% plus $\frac{1}{4}\%$; 1% of \$4000 is \$40, and $\frac{1}{4}\%$ of \$4000 is \$10; \$40 plus \$10 are \$50: the premium is \$50.

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6. \$5 is $\frac{5}{1000}$ of \$1000; $\frac{5}{1000}$ is .005 or $\frac{1}{2}\%$.

7. $\$75000 \times \frac{2}{3} = \$50000$;
$\$50000 \times .01\frac{1}{4} = \$625$, premium.

8. $\$7850 \times .00\frac{3}{4} = \$58.875$, premium on store;
$\$12400 \times .00\frac{1}{2} = \$62$, premium on goods;
$\$58.875 + \$62. = \$120.875$, total premium.

9. $\$5400 \times \frac{3}{4} = \$4050$;
$\$4050 \times .00\frac{7}{8} = \$35.4375$, premium;
$\$35.4375 + \$1.50 = \$36.9375$, cost.

10. $\$12400 \times \frac{2}{3} = \$8266\frac{2}{3}$; $\$8266\frac{2}{3} \times .00\frac{3}{4} = \$62$;
$\$62 + \$2.25 = \$64.25$, cost.

11. $\$135000 \times \frac{4}{5} = \$108000$, whole risk;
$\frac{1}{3} + \frac{2}{5} = \frac{11}{15}$; $\frac{15}{15} - \frac{11}{15} = \frac{4}{15}$, 3d co.'s part of risk;
$\$108000 \times \frac{1}{3} \times .00\frac{2}{4} = \$270$, prem. of 1st company;
$\$108000 \times \frac{2}{5} \times .00\frac{7}{8} = \$378$, prem. of 2d company;
$\$108000 \times \frac{4}{15} \times .00\frac{2}{8} = \$192$, prem. of 3d company;
$\$270 + \$378 + \$192 = \$840$, total premium.

12. $\$60000 \times \frac{1}{3} = \$20000$, loss of 1st company;
$\$60000 \times \frac{2}{5} = \$24000$, loss of 2d company;
$\$60000 \times \frac{4}{15} = \$16000$, loss of 3d company;

13. $\$50 \div \$10000 = .005$, or $\frac{1}{2}\%$.

14. $\$561 \div \$25500 = .022 = .02\frac{1}{3}$, or $2\frac{1}{3}\%$.

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15. $\$100 \div \$12500 = .008 = .00\frac{4}{5}$, or $\frac{4}{5}\%$.

16. $\$240 \div .02 = \$12000$, amount of goods.

17. $\$93.60 \div .006 = \$15600$, sum insured.

18. $\$525 \div .015 = \$35000$, sum insured.

20. $\$21825 \div .97 = \$22500$, sum insured and premium.

21. $\$11859.40 \div .985 = \$12040$, sum insured and premium.

22. $\$11520 \div .96 = \$12000$, sum insured and premium.

23. $\$35000 \times .01 = \$350$ premium;
$\$35000 - \$350 = \$34650$, value of goods.
Or, $\$35000 \times .99 = \$34650$, value of goods.

24. $\$23.60 \times 6 = \$141.60$, premium.

25. $\$44.50 \times 5 \times 10 = \$2225$, total premiums.

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2. (1) $\$259776 \div \$21648000 = .012 = 1\frac{1}{5}\%$.
(2) $1\frac{1}{5}\% = .012$, or 12 mills to $\$1$.

3. (1) $\$1.50 \times 540 = \$810$, amount of poll tax;
$\$19340.20 - \$810 = \$18530.20$, tax on property.
(2) $\$18530.20 \div \$1425400 = .013 = 1\frac{3}{10}\%$, or 13 mills to $\$1$.

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5. \$11703.845 ÷ .985 = \$11882.076+, tax collected;
\$11882.076+ ÷ .925 = \$12845.487+, tax assessed.

N. B.—The amount to be assessed to yield \$11703.84½ as net proceeds could be found, with sufficient accuracy for practical purposes, by the process described in the note on page 204.

6. \$145850 × .90 = \$131265, tax collected;
\$131265 × .00¾ = \$984.48¾, collection fee;
\$131265 — \$984.48¾ = \$130280.51¼, net proceeds.
Or, \$145850 × .90 = \$131265, tax collected;
\$131265 × .99¼ = \$130280.51¼, net proceeds.
7. \$87045060 × .0055 = \$478747.83, school tax.

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1. \$1.80 × 650 = \$1170; \$1170 × .33⅓ = \$390, duty.

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2. \$.62½ × 1500 = \$937.50;
\$937.50 × .40 = \$375, duty.
3. \$1.15 × 850 = \$977.50;
\$977.50 × .50 = \$488.75, duty.
4. \$.42 × 560 × 4 = \$940.80;
\$940.80 × .45 = \$423.36; duty.
5. \$.45 × 400 × 40 = \$7200;
\$.40 × 350 × 20 = \$2800;
\$7200 + \$2800 = \$10000, invoice cost;
\$10000 × .20 = \$2000, duty.
6. \$2.15 × 1450 = \$3117.50, invoice price of broadcloth;
\$1.60 × 3240 = \$5184.00, invoice price of carpet;
\$3117.50 + \$5184 = \$8301.50, inv. price woolen g'ds;
\$8301.50 × .35 = \$2905.525, duty on woolen goods;
\$2.85 × 480 = \$1368, invoice price of silks;
\$1368 × .50 = \$684, duty on silks;
\$2905.525 + \$684 = \$3589.525, total duty.

7. (1) $1100 ÷ .40 = $2750, invoice cost;
$2750 ÷ 1250 = $2.20, invoice price per yard.
(2) $2.20 × 1.40 = $3.08, cost including duty;
$3.08 × 1.20 = $3.696, selling price.

8. $17.50 × 240 = $4200, duty on the iron;
$22 × 75 = $1650, duty on the steel;
$4200 + $1650 = $5850, total duty.

9. 475 lb. × 225 = 106875 lb., weight of sugar;
3 cts. × 106875 = $3206.25, duty on sugar;
126 gal. × 120 = 15120 gal., of molasses;
8 cts. × 15120 = $1209.60, duty on molasses;
$3206.25 + $1209.60 = $4415.85, total duty.

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2. $3580 × .62 = $2219.60, share of 1st;
$4635 × .62 = $2873.70, share of 2d;
$5300 × .62 = $3286.00, share of 3d;
$2235 × .62 = $1385.70, share of 4th.

3. (1) $3500 + $1250 + $3750 + $1000 + $2500 = $12000, liabilities;
$7150 — $550 = $6600, net assets;
$6600 ÷ $12000 = .55, or 55%.
(2) $3500 × .55 = $1925, A's receipts;
$1250 × .55 = $687.50, B's receipts;
$3750 × .55 = $2062.50, C's receipts;
$1000 × .55 = $550, D's receipts;
$2500 × .55 = $1375, E's receipts.

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4. $9500 + $5400 + $2100 = $17000, assets;
$17000 × .95 = $16150, net assets;
$16150 ÷ $25000 = .646, or 64⅝ cents on a dollar.

1. (1) $7.50 ÷ .75 = $10, amount collected.
(2) $10 × .25 = $2.50, commission.

2. $160 ÷ .80 = $200, sale receipts.

3. $1280 \times .00\frac{3}{8} = \$4.80$, brokerage.
4. $15600 \times .00\frac{1}{4} = \$39.00$, brokerage on par value.

N. B.—See "Suggestion" under problem 18, page 198.

5. 70 cts. + 90 cts. = 160 cts.;
 160 cts. ÷ 2 = 80 cts., price of mixed tea;
 95 cts. — 80 cts. = 15 cts., gain per lb.;
 15 cts. ÷ 80 cts. = .18¾, or 18¾%.
6. 524 T. ÷ .655 = 800 T,. of ore.

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7. $.80 \times 500 = \$400$; $.85 \times 700 = \$595$;
 $.87\frac{1}{2} \times 800 = \$700$;
 $400 + $595 + $700 = $1695, total cost;
 500 bu. + 700 bu. + 800 bu. = 2000 bu.;
 $.92 \times 2000 = \$1840$, sale receipts;
 $1840 — $1695 = $145, gain;
 $145 ÷ $1695 = .08$\frac{1}{8}\frac{8}{8}\frac{8}{9}$, or $8\frac{1}{8}\frac{8}{8}\frac{8}{9}$%.
8. $1.80 ÷ 1.25 = $1.44, cost;
 $1.44 \times 1.20 = \$1.728$, selling price to gain 20%;
 $1.80 — $1.728 = $.072, reduction per yard;
 $.072 ÷ $1.80 = .04, or 4%, reduction.
9. $24000 \times \frac{3}{8} = \$16000$;
 $16000 \times .00\frac{3}{4} = \$120$, premium.
10. $150000 \times .00\frac{3}{4} = \$1125$, premium on block;
 $40000 \times .00\frac{7}{8} = \$350$; $35000 \times .00\frac{4}{5} = \$280$;
 $350 + $280 = $630, total paid for re-insuring;
 $1125 — $630 = $495, net premium.
11. $100\% - \frac{1}{2}\% = 99\frac{1}{2}\%$; $2587 ÷ .995 = \$2600$.
12. $3500 \times .00\frac{3}{8} \times 10 = \$210$, premium for 10 years;
 $3500 — $210 = $3290, excess.
13. $40000 \times .02\frac{1}{2} \times 20 = \$20000$, premiums for 20 yr.;
 $40000 — $20000 = $20000, loss.
14. $50400 \times .03\frac{1}{2} = \$1764$, premium;
 $50400 — $1764 = $48636, value of flour.

Or, $100\% - 3\frac{1}{2}\% = 96\frac{1}{2}\%$; $50400 \times .96\frac{1}{2} = \$48636$.

15. \$35460850 × .02½ = \$886521.25, tax assessed;
\$886521.25 × .92 = \$815599.55, tax collected;
\$815599.55 × .97 = \$791131.5635, net proceeds.

16. \$.62½ × 65 × 90 = \$3656.25, invoice cost of tea;
\$3656.25 × .40 = \$1462.50, duty on the tea;
\$.18¾ × 80 × 75 = \$1125, invoice cost of coffee;
\$1125 × .25 = \$281.25, duty on the coffee;
\$1462.50 + \$281.26 = \$1743.75, total duty.

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17. \$24414142 ÷ \$610728103 = 3.997+%.

18. \$70680 — \$40325 = \$30355, net earnings;
\$30355 — \$6505 = \$23850, amount divided;
\$23850 ÷ \$450000 = .05$\frac{3}{10}$ = 5$\frac{3}{10}$%.

19. 102½% + ¼% = 102¾%, total cost per cent;
107¼% — ⅛% = 107⅛%, net selling price per cent;
107⅛% — 102¾% = 4⅜%, gain per cent;
\$7500 × .04⅜ = \$328.125, gain.

Or, \$7500 × 1.02¾ = \$7706.25, cost;
\$7500 × 1.07⅛ = \$8034.375, sale receipts;
\$8034.375 — \$7706.25 = \$328.125, gain.

20. \$75 × 45 + \$125 × 9 = \$4500, sale receipts;
\$4500 — \$3375 = \$1125, commission;
\$1125 ÷ \$4500 = .25, or 25%, rate of commission.

21. \$15000 × .90 = \$13500, net proceeds of sale;
\$13500 ÷ 1.05 = \$12857.142+, amount invested;

22. (1) \$.22 × 3040 + \$.15 × 10560 = \$2252.80, sale rcts.;
\$2252.80 × .95 = \$2140.16, net proceeds of sales;
\$2140.16 ÷ 1.03 = \$2077.825+, amount invested.
(2) \$2252.80 × .05 = \$112.64, com. for selling;
\$2077.825+ × .03 = \$62.334+, com. for buying;
\$112.64 + \$62.334+ = \$174.974+, total commission.

Or, \$2252.80 — \$2140.16 = \$112.64, com. for selling;
\$2140.16 — \$2077.825+ = \$62.334+, com. for b'g;
\$112.64 + \$62.334+ = \$174.974+, total com.

23. (1) $\$5.75 \times 1300 = \$7475$, sale receipts;
$\$7475 \times .96\frac{1}{2} = \$7213.375$, net proceeds of sale;
$\$7213.375 \div 1.02 = \$7071.936+$, amount invested;
$\$7071.936+ \div \$.28 = 25256.914+$, no. of pounds.
(2) $\$7475 - \$7071.936+ = \$403.063+$, commission.
Or, $\$7475 \times .03\frac{1}{2} + \$7071.936+ \times .02 = \$403.063+$, com.

INTEREST.

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32. 1880 5 6
1876 9 12
3 yr. 7 mo. 24 da.
.219 (at 6%).

$108.60
.219
$23.78340, interest at 6%.
7.92780, " " 2%.
$31.71120, interest at 8%.

33. 1879 4 12
1875 10 23
3 yr. 5 mo. 19 da.
$.208\frac{1}{6}$

$1.580
$.208\frac{1}{6}$
$3.289031\frac{1}{3}$, interest at 6%.
1.64451+, " " 3%.
$4.93354+, interest at 9%.

34. 1879 11 28
1874 6 3
5 yr. 5 mo. 25 da.
$.329\frac{1}{6}$

$565.80
$.329\frac{1}{6}$
$186.2425, interest at 6%.
31.0404+, " " 1%.
$217.2829+, interest at 7%.
$565.80
$783.0829+, amount.

35. 1876 3 4 — $60
1874 5 10 — .109

1 yr. 9 mo. 24 da. — $6.540, interest at 6%.
.109 — 60.00
$66.540, amount.

36. 1880 5 21 — $40.50
1874 11 9 — .332

5 yr. 6 mo. 12 da — $13.446, interest at 6%.
.332 — 40.50
$53.946, amount.

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37. 1878 4 11 — $350
1875 10 17 — .149

2 yr. 5 mo. 24 da. — $52.150, interest at 6%.
.149 — 8.691+, " " 1%.
$60.841+, interest at 7%.
350.
$410.841+, amount.

38. 1880 1 .1 — $150.75
1877 6 15 — .152⅔

2 yr. 6 mo. 16 da. — $23.0145, interest at 6%.
.152⅔ — 3.83575, " " 1%.
$19.17875, interest at 5%.
150.75
$169.92875, amount.

39. 1880 6 1 — $1250
1878 7 5 — .114⅓

1 yr. 10 mo. 26 da. — $142.916⅔, interest at 6%.
.114⅓ — 47.638⅔, " " 2%.
$190.555+, interest at 8%.
1250.
$1440.555+, amount.

40. 1879 3 25
1877 8 8
1 yr. 7 mo. 17 da.
.097$\frac{5}{6}$

\$87.50
.097$\frac{5}{6}$
\$8.56041+, interest at 6%.
1.42673+, " " 1%.
\$14.2673+, interest at 10%.
87.50
\$101.7673+, amount.

41. 1880 6 25
1878 2 20
2 yr. 4 mo. 5 da.
.140$\frac{5}{6}$

\$65.80
.140$\frac{5}{6}$
\$9.26683$\frac{1}{3}$, interest at 6%.
1.54447+, " " 1%.
\$10.81130+, interest at 7%.
65.80
\$76.6113, amount.

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7. 81 da. $\therefore$.013$\frac{1}{2}$

\$420
.013$\frac{1}{2}$
5.670, int. at 6%.
1.890, " " 2%.
\$7.560, int. at 8%.
420.00
\$427.56, amount.

8. 110 da. $\therefore$.018$\frac{1}{3}$

\$150
.018$\frac{1}{3}$
2.750, int. at 6%.
.458$\frac{1}{3}$, " " 1%.
\$3.208$\frac{1}{3}$, int. at 7%.
150.00
\$153.208$\frac{1}{3}$, amount.

9. 157 da. $\therefore$.026$\frac{1}{6}$

\$80
.026$\frac{1}{6}$
\$2.093$\frac{1}{3}$, int. at 6%.
697$\frac{7}{9}$, " " 2%.
\$2.791+, int. at 8%.
80.
\$82.791+, amount.

10. 96 da. $\therefore$.016

\$150
.016
\$2.40, int. at 6%.
.60, " " 1$\frac{1}{2}$%.
\$3.00, int. at 7$\frac{1}{2}$%.
150.
\$153.00, amount.

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8. 123 da. $\therefore .020\frac{1}{2}$

$56

$.020\frac{1}{2}$

3) $1.148, int. at 6%.

$.382\frac{2}{3}$ " " 2%.

$1.530\frac{2}{3}$, int. at 8%.

56.

$54.469\frac{1}{3}$, proceeds.

9. 76 da. $\therefore .012\frac{2}{3}$

$120

$.012\frac{2}{3}$

3) $1.520, int. at 6%.

$.253\frac{1}{3}$, " " 1%.

$.253\frac{1}{3} \times 10 = \$2.533\frac{1}{3}$, int. at 10%.

120.

$117.466\frac{2}{3}$, proceeds.

10. 68 da. $\therefore .011\frac{1}{3}$

$500

$.011\frac{1}{3}$

6) $5.666\frac{2}{3}$, int. at 6%.

$.944\frac{4}{9}$, " " 1%.

$6.611\frac{1}{9}$, int. at 7%.

500.

$493.388\frac{8}{9}$, proceeds.

11. 114 da. $\therefore .019$

$8.75

.019

3) $.16625, int. at 6%;

$5541\frac{2}{3}$ " " 2%;

$.22166\frac{2}{3}$ " " 8%.

8.75

$8.52833\frac{1}{3}$, proceeds.

12. 145 da. $\therefore .024\frac{1}{6}$.

$400

$.024\frac{1}{6}$

3) $9.666\frac{2}{3}$, int. at 6%.

$3.222\frac{2}{3}$, " " 2%.

$12.888\frac{8}{9}$, int. at 8%.

400.

$387.111\frac{1}{9}$, proceeds.

13. April, 20 days.

May, 31 "

June, 30 "

81 days.

93 "

12 days.

July 12th, date.

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17. 63 da. $\therefore .0105$ (int.); 59 da. $\therefore .009\frac{5}{6}$ (dis.);

$125 \times 1.0105 = \$126.3125$, amount discounted;

$126.3125 \times .009\frac{5}{6} \times \frac{10}{6} = \$2.0701+$, dis. at 10%;

$126.3125 - \$2.0701+ = \$124.242+$, proceeds.

NOTE.—The discount is computed on the *amount* of the note at the time of its *maturity*, and for the time between the date of discounting and the date of maturity.

18. 6 mo. 3 da. $\therefore$.0305; 83 da. $\therefore$.013$\frac{5}{6}$;
$1000 $\times$.0305 $\times$ $\frac{7}{6}$ = 35.583\frac{1}{3}$, interest at 7%;
$1000 + 35.583\frac{1}{3}$ = 1035.583\frac{1}{3}$, due Feb. 18, 1880;
1035.583\frac{1}{3}$ $\times$.013$\frac{5}{6}$ $\times$ $\frac{3}{2}$ = $21.4883+, dis. at 9%.

19. 4 mo. 3 da. $\therefore$.0205 (int.); 75 da. $\therefore$.012$\frac{1}{2}$ (dis.);
$90 + ($90 $\times$.0205 $\times$ $\frac{5}{6}$) = $91.5375, amount at 5%;
$91.5375 $\times$.012$\frac{1}{2}$ $\times$ $\frac{7}{6}$ = $1.3349, discount at 7%;
$91.5375 — $1.3349 = $90.2026, proceeds.

20.

$650.
.065$\frac{1}{3}$
42.466\frac{2}{3}$, int. for 1 yr., 1 mo., 2 da., at 6%.
650.
692.466\frac{2}{3}$, amt. due Apr. 4, 1870 (grace).
.01.
6.924\frac{2}{3}$, dis. for 60 days.
692.466$\frac{2}{3}$
$685.542, proceeds Feb. 3, 1870.

N. B.—Solution of problem as revised in 1890.

22. 93 da. $\therefore$.0155; $1 — $.0155 = $.9845, proceeds of $1;
$1969 $\div$.9845 = $2000, face of note.

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23. 4 mo. 3 da. $\therefore$.0205; .0205 $\times$ $\frac{3}{2}$ = .03075;
$1. — $.03075 = $.96925, proceeds of $1 at 9%;
$811 $\div$.96925 = $836.728+, face of note.

24. 3 mo. 3 da. $\therefore$.0155; .0155 $\times$ 2 = .031;
$1 $\div$ $.031 = $.969, proceeds of $1 at 12%;
$1938 $\div$.969 = $2000, face of note.

25. 4 mo. $\therefore$.02; $.02 \times \frac{10}{6} = .03\frac{1}{3}$;
$\$750 \times .03\frac{1}{3} = \$25$, discount at 10%;
$\$750 - \$25 = \$725$, cash proceeds.

26. 9 mo. $\therefore$.045; $.045 \times \frac{8}{6} = .06$;
$\$340 \times .06 = \$20.40$, discount at 8%;
$\$340 - \$20.40 = \$319.60$, cash proceeds.

27. $\$1030 \times .05 = \$51.50$, discount;
$\$1030 - \$51.50 = \$978.50$, cash proceeds.
Or, $100\% - 5\% = 95\%$; $\$1030 \times .95 = \$978.50$.

28. $100\% - 7\frac{1}{2}\% = 92\frac{1}{2}\%$;
$\$950 \times .92\frac{1}{2} = \$878.75$, proceeds.

29. $100\% - 5\% = 95\%$;
$\$675 \times .95 = \$641.25$, proceeds.

30. $\$725 \times .04 = \$29$; $\$725 - \$29 = \$696$, cash value;
$\$696 \div .9775 = \$712.020+$, face of note;
$\$725 - \$712.020+ = \$12.979+$, gain.

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31. $\$3540 \times .05 = \$177$;
$\$3540 - \$177 = \$3363$, cash value;
92 da. $\therefore$ $.015\frac{1}{3}$; $.015\frac{1}{3} \times \frac{10}{6} = .025\frac{5}{9} = .02\frac{5}{9}$ (at 10%);
$\$3363 \div .97\frac{7}{9} = \$3451.1972+$, face of note;
$\$3540 - \$3451.1972 = \$88.8028$, gain.

NOTE.—The number of days in 3 months from March 20th is 92, and to obtain $3363 from bank he must give his note for a sum which, discounted at 10% for 92 days (without grace), will give $3363 as proceeds. The note would be drawn for 3 months without grace, or for 92 days without grace.

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2. 1877 12 4
1877 6 10
5 mo. 24 da.
$50. .029.

1878 3 25
1877 12 4
3 mo. 21 da.
$12. .018½.

1878 7 9
1878 3 25
3 mo. 14 da.
$75. .017½.

1878 10 15
1878 7 9
3 mo. 6 da.
.016.

$600
.029
$17.40, 1st interest.
600.
$617.40
50. 1st payment.
567.40
.018½
28370
453920
56740
$10.4969, 2d interest.
567.40
$577.8969
12. 2d payment.
$565.8969
.017½
1886323
39612783
5658969
$9.8088796, 3d interest.
565.8969
$575.7058
75. 3d payment.
$500.7058
.016
30042348
5007058
$8.0112928, 4th interest.
500.7058
$508.7171, due Oct. 15, 1878.

3. 1875 11 10
1874 4 10
1 yr. 7 mo.
$80.50. .095.

1876 7 5
1875 11 10
7 mo. 25 da.
$100. .039⅙.

1877 1 10
1876 7 5
6 mo. 5 da.
$450.80. .030⅚.

1879 10 1
1877 1 10
2 yr. 8 mo. 21 da.
$500. .163½.

1880 1 1
1879 10 1
3 mo.
.015.

$1000
.095
6)95.000
15.8333
$110.8333, 1st interest.

$1000
.039⅙
6)39.1667
6.5278
$45.6945, 2d interest.
110.8333, 1st interest.
1000.
$1156.5278
180.50, 1st & 2d payt.
$976.0278
.030⅚
6)$30.0941905
5.0157
$35.1098, 3d interest.
976.0278
$1011.1376
450.80, 3d payment.
$560.3376
.163½
6)$91.6151976
15.26919
$106.8844, 4th interest.
560.3376
$667.222
500. 4th payment.
167.222
.015
6)$2.50833
.41805
$2.9264, 5th interest.
167.222
$170.148, amount due Jan. 1, 1880.

4.

1879	1	20	
1878	7	4	
	6 mo.	16 da.	
$15.	.032⅔.		

$450.
.032⅔
6) $14.700
2.45
$24.50, 1st interest.

$450.
.023⅓
6) $10.425
1.7375
$17.375, 2d interest.
24.50, 1st interest.
450.
$491.875

1879	10	20	
1879	6	9	
	4 mo.	11 da.	
$10.	.021⅔.		

215. 1st & 2d payments.
$276.875
.021⅔
6) 6.045104
1.007517
$10.0751, 3d interest.

1880	1	10	
1879	10	20	
	2 mo.	20 da.	
	.013⅓.		

$276.875
.013⅓
6) 3.691667
.615278
$6.15278, 4th interest.
10.0751, 3d interest.
276.875
$293.10288
10. 3d payment.
$283.103, amount due.

NOTE.—Interest at 10% is found by dividing interest at 6% by 6 and removing decimal point in quotient one place to the right.

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5. 1875 9 1 — 1877 1 20
1875 3 4 — 1876 9 15
5 mo. 27 da. — 4 mo. 5 da.
$12. .029½. — $400. .020⅝.

1876 5 4 — 1878 7 1
1875 9 1 — 1877 1 20
8 mo. 3 da. — 1 yr. 5 mo. 11 da.
$10. .040½. — .086⅛.

1876 9 15
1876 5 4
4 mo. 11 da.
$250. .021⅝.

$850
.029½ + .040½ + .021⅝ = .091⅝
$78.0583, 1st, 2d, and 3d interests.
850.
$928.0583
$12 + $10 + $250 = 272. 1st, 2d, and 3d payments.
$656.0583
.020⅝
$13.6678812, 4th interest.
656.0583
$669.7262
400. 4th payment.
$269.7262
.086⅝
$23.4212250, 5th interest.
269.7262
$293.147, amount due July 1, 1878.

NOTE.—It is seen by inspection that the first and second interests in problem 5 will each be less than the corresponding payment, and, instead of finding each interest separately, the *sum* of the first three interests are found by multiplying the principal by the *sum* of the first three decimal multipliers. See New Complete Arithmetic, page 232, note 1.

6.

1878	9	14			$1250.	
1878	7	1			.012$\frac{1}{6}$	
	2 mo.	13	da.		4)15.208	
$300.	.012$\frac{1}{6}$.				3.802	
					$19.010,	1st interest.
1879	1	20			1250.	
1878	9	14			$1269.01	
	4 mo.	6	da.		300.	1st payment.
$12.	.021.				$969.01	
					.069	
1879	10	20			4)66.86169	
1879	1	20			16.71542	
	9 mo.	0	da.		$83.577,	2d, 3d, & 4th int.
$20.	.045.				969.01	
					$1052.587	
1879	11	8			532.	2d, 3d, & 4th pay't.
1879	10	20			$520.587	
		18	da.		.008$\frac{5}{6}$	
$500.	.003.				4)4.598518	
					1.149629	
1880	1	1			$5.748,	5th interest.
1879	11	8			520.587	
	1 mo.	23	da.		$526.335,	amount due.
	.008$\frac{5}{6}$.					

NOTE.—It is seen by inspection that the second and third interests will each be less than the payment, and so the sum of the second, third, and fourth decimal multipliers are used. .021 + .045 + .003 = .069.

7. 1881 7 28
1881 4 10
3 mo. 18 da.
$500. .018.

1881 12 13
1881 7 28
4 mo. 15 da.
$8. .022½.

1882 2 25
1882 12 13
2 mo. 12 da.
$12. .012.

1882 7 7
1882 2 25
4 mo. 12 da.
$125. .022.

1882 10 3
1882 7 7
2 mo. 26 da.
$200. .014⅓.

1883 3 15
1882 10 3
5 mo. 12 da.
$50. .027.

1883 6 3
1883 3 15
2 mo. 18 da. .013.

$206.335
.013
6)2.682355
.447059
$4.471, 7th interest.
206.335
$210.806, amount due.

$1000.
.018
6)18.000
3.00, int. at 1%.
$30.00, 1st interest.
1000.
$1030.00
500. 1st payment.
$530
.056½
6)29.945
4.9908
$49.908, 2d, 3d, 4th int.
530.
$579.908
145.00, 2d, 3d, 4th payt.
$434.908
.014⅓
6)6.233681
1.038947
$10.389, 5th interest.
434.908
$445.297
200. 5th payment.
$245.297
.027
6)6.623019
1.103837
$11.038, 6th interest.
245.297
$256.335
50. 6th payment.
$206.335

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8. 1883 10 18 — 1883 4 12 — 6 mo. 6 da. — .031.

$520 × .031 = 3)$16.120 = 5.373⅓ + 520. = $541.493⅓, am't of prin.

1883 5 20 — 4 mo. 28 da. — $120. — .024⅔.

$120 × .024⅔ = 3)$2.960 = .986⅔ + 120. = $123.946⅔, am't of 1st payt.

1883 6 9 — 4 mo. 9 da. — $12. — .021½.

$12 × .021½ = 3).258 = .086 + 12. = $12.344, am't of 2d payt.

1883 7 21 — 2 mo. 27 da. — $85. — .014½.

$85 × .014½ = 3)$1.232½ = .410⅚ + 85. = $86.643⅓, am't of 3d payt.

Principal amount,	$541.493⅓
1st p. am't,	$123.946⅔
2d " "	12.344
3d " "	86.643⅓
Payment amounts,	$222.934
Amount due,	$318.559⅓

9.	Principal,		$800.
	Interest for 9 months 18 days, at 8%,		51.20
			$851.20
	First payment,	$200.	
	Interest for 7 months 15 days,	10.	
	Second payment,	$75.	
	Interest for 4 months 20 days,	2.333	
	Third payment,	$125.	
	Interest for 2 months 10 days,	1.944	
			414.277
	Amount due December 30, 1882,		$436.923
10.	Principal,		$350.
	Interest for 9 months, at 6%,		15.75
			$365.75
	First payment,	$45.	
	Interest for 7 months 11 days,	1.657	
	Second payment,	$60.	
	Interest for 6 months,	1.80	
	Third payment,	$80.	
	Interest for 3 months 26 days,	1.547	
	Fourth payment,	$50.	
	Interest for 1 month,	.25	
			$240.254
	Amount due November 1, 1882,		$125.496

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3. 3 yr. 6 mo. + 2 yr. 6 mo. + 1 yr. 6 mo. + 6 mo. = 8 yr.; 4 yr. 6 mo. = $4\frac{1}{2}$ yr.;

$1000 \times .06 = $60, annual interest;

$60 \times 4\frac{1}{2} = $270, total interest on principal;

$60 \times .06 \times 8 = $28.80, int. on annual interests;

$1000 + $270 + $28.80 = $1298.80, amount due.

4. 3 yr. + 2 yr. + 1 yr. = 6 yr., time of int. on an. int.;
$3500 × .06 = $210, annual interest;
$210 × 4 = $840, total interest on principal;
$210 × .06 × 6 = $75.60, int. on annual interest;
$3500 + $840 + $75.60 = $4415.60, amount due.

5. (1) 2 yr. 6 mo.; $2\frac{1}{2}$ years; $1\frac{1}{2}$ yr. + $\frac{1}{2}$ yr. = 2 yr.;
$650 × .07 = $45.50, annual interest;
$45.50 × $2\frac{1}{2}$ = $113.75, total int. on principal;
$45.50 × .07 × 2 = $6.37, int. on an. int. at 7%;
$650 + $113.75 + $6.37 = $770.12, amount due.
(2) $45.50 × .06 × 2 = $5.46, int. on an. int. at 6%;
$650 + $113.75 + $5.46 = $769.21, amount due;

6. (1) 3 yr. 2 mo. 12 da. = 3.2 yr.;
2.2 yr. + 1.2 yr. + .2 yr. = 3.6 yr.;
$650 × .07 = $45.50, annual interest;
$45.50 × 3.2 = $145.60, total int. on principal;
$45.50 × .07 × 3.6 = $11.466, int. on an. int. at 7%;
$650 + $145.60 + $11.466 = $807.066, amount due.
(2) $45.50 × .06 × 3.6 = $9.828, int. on an. int. at 6%;
$650 + $145.60 + $9.828 = $805.428, amount due.

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8. $500 × .10 = $50, first annual interest;
$50 × 2 = $100, an. int. due Jan. 15, 1867;
$50 × .10 = 5, int. on 1st annual interest;
$500
$605, amount due Jan. 15, 1867;

Payment, $100.00
Int. for same, 6.50 } = $106.50, am't of $100 Jan. 15, 1867;
$498.50, new principal.

$498.50 × .05 = 24.925, int. due July 15, 1867;
$523.425, am't " " " "

Payment, $200
Int. on same, 7 } = $207. am't of $200 July 15, 1867;
$316.425, amount due at maturity.

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3. (2) \$1500.
1.08
\$1620, amount due in 1 year;
1.08
\$1749.60, amount due in 2 years;
1.08
\$1889.568, amount due in 3 years;
1500.
\$389.568, compound interest.

4. \$800.
1.03
\$824.00, amount due in ½ year;
1.03
\$848.72, amount due in 1 year;
1.03
\$874.1816, amount due in 1½ years;
1.03
\$900.407+, amount due in 2 years.

5. \$650.
1.06
\$689.00, amount due in 1 year;
1.06
\$730.34, amount due in 2 years;
1.06
\$774.1604, amount due in 3 years;
1.022
\$791.1919288, amount due in 3 yr. 4 mo. 12 da.;
650.
\$141.1919+, compound int. in 3 yr. 4 mo. 12 da.

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5. 2 yr. 6 mo. 15 da. $\therefore .15\frac{1}{4}$; $1.00 + .15\frac{1}{4} = 1.15\frac{1}{4}$;
$\$345.60 \times 1.15\frac{1}{4} = \$398.304$, amount.

6. 2 yr. 2 mo. 3 da. $\therefore .1305$;
$\$252 \times .1305 \times \frac{7}{6} = \$38.367$;
$\$252 + \$38.367 = \$290.367$, amount.

7. (2) 132 da. $\therefore .022$; $\$80.25 \times .022 \times \frac{4}{3} = \$2.354$, int.

8. 89 da. $\therefore .014\frac{5}{6}$; $\$920 \times .014\frac{5}{6} \times \frac{3}{2} = \$20.47$, int.;
$\$920 + \$20.47 = \$940.47$, amount.

9. 175 da. $\therefore .029\frac{1}{6}$; $\$7.50 \times .029\frac{1}{6} \times \frac{4}{3} = \$.2916$, int.;
$\$7.50 + \$.2916 = \$7.7916$, amount.

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14. 1 yr. 2 mo. 12 da. $\therefore .072$;
$\$240 \times .072 \div 6 = \$2.88$, int. at 1%;
$\$23.04 \div \$2.88 = 8$, the rate.

15. 7 mo. 7 da. $\therefore .036\frac{1}{6}$;
$\$252 \times .036\frac{1}{6} \div 6 = \$1.519$, int. at 1%;
$\$12.152 \div \$1.519 = 8$, the rate.

16. 2 yr. 6 mo. 15 da. $\therefore .15\frac{1}{4}$;
$\$345.60 \times .15\frac{1}{4} \div 6 = \$8.784$, int. at 1%;
$\$407.088 - \$345.60 = \$61.488$, interest;
$\$61.488 \div \$8.754 = 7$, the rate

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19. $\$56.78 \times .10 = \$5.678$, interest for 1 year;
$\$22.24 \div \$5.678 = 3.9168+$, number of years;
.9168 yr. = .9168 mo. $\times$ 12 = 11.0016 mo.;
3.9168 yr. = 3 yr. 11.0016 mo.; or 3 yr. 11 mo.+.

20. $\$300 \times .06 = \$18$, interest for 1 year;
$\$347.25 - \$300 = \$47.25$, interest;
$\$47.25 \div \$18 = 2.625$, number of years;
2.625 yr. = 2 yr. 7.5 mo. = 2 yr. 7 mo. 15 da.

21. (1) $\$1 \div \$.04 = 25$, number of years;
Or, $100\% \div 4\% = 25$, number of years.

NOTE.—Any principal will double itself in the time required for the interest of \$1 to equal \$1, or for the interest of any other principal to equal itself. Or, it will take as many years for any principal to double itself as the given rate is contained times in 100. It will take any principal 25 years to double itself at 4% interest; $16\frac{2}{3}$ years, at 6%; and 10 years, at 10%.

23. (1) $\$2 \div \$.05 = 40$, number of years.
Or, $200\% \div 5\% = 40$, number of years.

NOTE.—Any principal trebles itself when the interest becomes twice the principal.

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26. 5 yr. 6 mo. 20 da. $\therefore .333\frac{1}{3} = .33\frac{1}{3}$;
$.33\frac{1}{3} \times \frac{5}{6} = .27\frac{7}{9}$ (at 5%);
$\$1000 \div .27\frac{7}{9} = \$3600$, principal.

30. 4 mo. 12 da. $\therefore .022$; $.022 \times \frac{4}{3} = .029\frac{1}{3}$ (at 9%);
$\$220 \div .029\frac{1}{3} = \$7500$, principal.

31. (1) 63 da. $\therefore .0105$; $.0105 \times \frac{2}{3} = .007$ (at 4%);
$\$17.78 \div .0105 = \$1693\frac{1}{3}$.
(2) $\$17.78 \div .007 = \$2540$, at 4%.

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35. 2 yr. 1 mo. 15 da. $\therefore .1275$; $.1275 \times \frac{4}{3} = .17$ (at 8%);
$\$421.20 \div \$1.17 = \$360$, principal;

36. 1 yr. 4 mo. 21 da. $\therefore .0835$;
$\$2600.40 \div 1.0835 = \$2400$, principal.

37. 1 yr. 6 mo. 18 da. $\therefore .093$; $.093 \times \frac{4}{3} = .124$ (at 8%);
$\$843 \div 1.124 = \$750$, principal.

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1. 2 yr. 5 mo. 24 da. $\therefore .149$;
$\$205 \times .149 \times \frac{7}{6} = \$35.63\frac{5}{6}$, interest.

2. 1 yr. 5 mo. 21 da. $\therefore$.0885;
.0885 $\times \frac{4}{5}$ = .118 (at 8%);
\$160 $\times$ 1.118 = \$178.88, amount.

3. 8 mo. 12 da. = .042;
\$512 $\times$.042 $\div$ 6 = \$3.584, int. at 1%;
\$25.088 $\div$ \$3.584 = 7, the rate.

4. 2 yr. 24 da. $\therefore$.124;
126.75 $\times$.124 $\div$ 6 = \$2.6195, int. at 1%;
\$20.956 $\div$ \$2.6195 = 8, the rate.

5. \$5000 $\times$.08 = \$400, interest of 1 year;
\$1125 $\div$ \$400 = $2\frac{3}{16}$, number of years;
.$\frac{3}{16}$ yr. = $9\frac{3}{4}$ mo.; $\frac{3}{4}$ mo. = $22\frac{1}{2}$ da.;
$2\frac{3}{16}$ yr. = 2 yr. 9 mo. 23 da.

6. \$326.50 $\times$.08 = \$26.12, interest of 1 year;
\$2.76 $\div$ \$26.12 = .1056+, part of year;
.1056 yr. = 1.2672 mo.; .2672 mo. = 8.016 da.;
.1056 yr. = 1 mo. 8 da.+

7. \$1563.75 — \$63.75 = \$1500, principal:
\$1500 $\times$.07$\frac{1}{2}$ = \$112.50, interest for 1 year;
\$63.75 $\div$ \$112.50 = .56$\frac{2}{3}$, part of year;
.56$\frac{2}{3}$ yr. = 6.8 mo.; .8 mo. = 24 da.;
.56$\frac{2}{3}$ yr. = 6 mo. 24 da.

8. 20 da. $\therefore$.003$\frac{1}{3}$; \$1.36 $\div$.003$\frac{1}{3}$ = \$408, principal.

9. 8 mo. $\therefore$.04; .04 $\times \frac{7}{6}$ = .04$\frac{2}{3}$ (at 7%);
1 + .04$\frac{2}{3}$ = 1.04$\frac{2}{3}$;
\$659.40 $\div$ 1.04$\frac{2}{3}$ = \$630, principal.

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10. 2 yr. 1 mo. 4 da. $\therefore$.125$\frac{2}{3}$;
\$4.474 $\div$.125$\frac{2}{3}$ = \$35.602+.

11. 1 yr. 2 mo. 6 da. $\therefore$.071;
\$12.78 $\div$.071 = \$180, principal;
\$180 + \$12.78 = \$192.78, amount.

12. 4 mo. 18 da. $\therefore$.023; .023 $\times \frac{2}{3}$ = .015$\frac{1}{3}$ (at 4%);
\$609.20 $\div$ 1.015$\frac{1}{3}$ = \$600, principal.

13. 1 yr. 6 mo. $\therefore$.09; \$288.85 $\div$ 1.09 = \$265, principal.

14. 9 mo. 19 da. $\therefore$.048$\frac{1}{6}$; .048$\frac{1}{6}$ $\times$ $\frac{7}{6}$ = .056$\frac{7}{36}$ (at 7%);
\$20.23 $\div$ \$.056$\frac{7}{36}$ = \$360, principal.

15. (1) \$2 $\div$ \$.06 = 33$\frac{1}{3}$, number of years.
Or, 200% $\div$ 6% = 33$\frac{1}{3}$, number of years.

16. 7 mo. 11 da. $\therefore$.036$\frac{5}{6}$;
\$420 $\times$.036$\frac{5}{6}$ $\times$ $\frac{10}{6}$ = \$25.783+, interest;
\$420 + \$25.783 = \$445.783, amount.

17. \$1000 $\div$.05 = \$20000, principal.

18. \$900 $\div$.045 = \$20000, principal.

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2. (1) 8 mo. $\therefore$.04; \$260 $\div$ 1.04 = \$250, pres. worth.
(2) \$260 — \$250 = \$10, true discount.

3. 1 yr. 6 mo. $\therefore$.09; .09 $\times$ $\frac{7}{6}$ = .105 (at 7%);
\$220 $\div$ 1.105 = \$199.095+, present worth.

4. 8 mo. 12 da. $\therefore$.042; .042 $\times$ $\frac{4}{3}$ = .056 (at 8%);
\$145.60 $\div$ 1.056 = \$137.8787+, present worth;
\$145.60 — \$137.8787+ = \$7.7212+, true discount.

5. 9 mo. 6 da. $\therefore$.046; .046 $\times$ $\frac{3}{2}$ = .069 (at 9%);
\$305.75 $\div$ 1.069 = \$286.014+, present worth.

6. 1 yr. 7 mo. 21 da. $\therefore$.0985;
.0985 $\times$ $\frac{5}{6}$ = .0820$\frac{5}{6}$ (at 5%);
\$1250 $\div$ 1.0820$\frac{5}{6}$ = \$7500 $\div$ 6.4925 = \$1155.179+;
\$1250 — \$1155.179+ = \$94.82+, true discount.

7. 90 da. $\therefore$.015; .015 $\times$ $\frac{7}{6}$ = .0175 (at 7%);
\$1508 $\div$ 1.0175 = \$1482.063+, present worth;
\$1508 — \$1482.063+ = \$25.936+, true discount.

8. 36 da. $\therefore$.006; .006 $\times$ $\frac{10}{6}$ = .01 (at 10%);
\$2040.50 $\div$ 1.01 = \$2020.297+, present worth;
\$2040.50 — \$2020.297+ = \$20.202+, true discount.

9. \$216 $\div$ 1.16 = \$186.206+, present worth;
\$216 — \$186.206+ = \$29.793+, true discount;
\$216 $\times$.16 = \$34.56, interest;
\$34.56 — \$29.793+ = \$4.766+, difference.

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10. $199.80 ÷ 1.11 = $180, present worth;
$199.80 — $180 = $19.80, true discount;
$199.80 × .11 = $21.978, interest;
$21.978 — $19.80 = $2.178, difference.

11. $442 ÷ 1.105 = $400, pres. worth and face of note.

NOTE.—The present worth of $442 put at interest at the given rate will amount to $442 in the given time, and hence the present worth of $442, which is $400, is the face of the note.

12. $371 ÷ 1.06 = $350, present worth of note;
$350 — $345 = $5, difference.

NOTE.—The present or cash value of the note is $5 more than $345 cash.

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1. $50000 × 1.19 = $59500, cost.

2. $3000 × 1.025 = $3075, cost.

3. $24000 × 1.125 = $27000, cost.

5. $3680 ÷ 1.15 = $3200, amount of stock.

6. (1) $34000 × .045 = $1480, annual income.

7. $11960 ÷ 1.15 = $10400, stock at 115;
$7680 ÷ .80 = $9600, stock at 80;
$10400 — $9600 = $800, difference.

8. (1) $8500 × .04 = $340, income.
(2) $8500 × .07 = $595, income.

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10. (1) $2863 ÷ .07 = $40900, amount of stock.
(2) $3570 ÷ .07 = $51000, amount of stock.

11. (1) $1250 × 2 = $2500, annual income;
$2500 ÷ .05 = $50000, amount of stock.
(2) $1750 × 2 = $3500, annual income.
$3500 ÷ .05 = $70000, amount of stock.

12. $3000 × .07 = $210; $3500 × .06 = $210;
$210 + $210 = $420, total annual income.

13. $210 × 4 = $840, annual income;
$840 ÷ $21000 = .04, the rate % of interest.

14. $1500 × 2 = $3000, annual income;
$3000 ÷ $50000 = .06, the rate % of interest.

15. $4250 × 4 = $17000, annual income;
$17000 ÷ .05 = $340000, fund invested.

17. $616000 ÷ 1.12 = $550000, amount of bonds;
$550000 × .06 = $33000, annual income.

18. $6900 ÷ 1.15 = $6000, amount of bonds;
$6000 × .07 = $420, annual income.

20. $100 × .87½ = $87.50, cost;
$100 × .03½ = $3.50, interest;
$3.50 ÷ $87.50 = .04, rate % of int. on investment.
Or, 3½% ÷ 87½% = .04, rate % of int. on investment.

21. $100 × .05 = $5, interest on $100 bond at 5%;
$5 ÷ .06 = $83⅓, prin. required to give $5 int. at 6%;
$83⅓ (cost) ÷ $100 (face) = .83⅓, or 83⅓%.
Or, 5% ÷ 6% = .83⅓.

NOTE.—The yearly interest on $100 at 5% is $5, and it will take as many dollars to yield $5 at 6% as $.06 is contained times in $5, which is 83⅓; $83⅓ is 83⅓% of $100. It is also seen that the two principals must be to each other inversely as their rates of interest, and, since 5 ÷ 6 = .83⅓, the cost of the $100 bond must be 83⅓% of its face. Proof: $100 × .05 = $83⅓ × .06.

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22. $100 × .04 = $4, interest on $100 bond at 4%;
$4 ÷ .05 = $80, prin. required to give $4 int. at 5%;
$80 (cost) ÷ $100 (face) = .80, or 80%.

23. $8000 × 1.20 = $9600, sale receipts at 120;
$9600 ÷ .96 = $10000, amount of stock bought;
$8000 × .06 = $480, first annual income;
$10000 × .04½ = $450, second annual income;
$480 — $450 = $30, loss in annual income.

24. $\$8000 \times .87\frac{1}{2}\ [\frac{7}{8}] = \$7000$, sale receipts;
$\$7000 \div 1.16\frac{2}{3}\ [\frac{7}{6}] = \$6000$, amount bought;
$\$8000 \times .03\frac{1}{2} = \$280$; $\$6000 \times .05 = \$300$;
$\$300 - \$280 = \$20$, gain in annual income.

25. $\$320000 \times 1.12\frac{1}{2}\ [\frac{9}{8}] = \$360000$, sale receipts;
$\$360000 \times 1.00 = \$360000$, Indiana bonds bought
$\$320000 \times .06 = \$19200$; $\$360000 \times .05 = \$18000$;
$\$19200 - \$18000 = \$1200$, loss in income.

26. $\$6550 \div 1.10 = \$5954\frac{6}{11}$, amount of stock;
$\$5954\frac{6}{11} \times .08 = \$476.363\frac{7}{11}$, annual income.

27. $\$6000 \times 1.15 = \$6900$, sale receipts;
$\$6900 \div 1.20 = \$5750$, amount of gas stock bought;
$\$6000 \times .06 = \$360$; $\$5750 \times .08 = \$460$;
$\$460 - \$360 = \$100$, gain in income.

28. $\$7200 \div 1.20 = \$6000$, amount of Mich. 7's bought;
$\$7200 \times .05 = \$360$; $\$6000 \times .07 = \$420$;
$\$420 - \$360 = \$60$, gain in income.

29. (1) $\$2760 \div 1.15 = \$2400$, amount of bank-stock;
$\$180 \div \$2400 = .07\frac{1}{2}$, rate % of dividend.
(2) $\$180 \div \$2760 = .06\frac{1}{23}$, rate % of interest.

30. (1) $6\% - 2\% = 4\%$, net % Mich. 6's;
$4\frac{1}{2}\% - 4\% = \frac{1}{2}\%$, difference in favor of U. S. $4\frac{1}{2}$'s.
(2) $6\% - 1\frac{1}{2}\% = 4\frac{1}{2}\%$, net % Mich. 6's;
$4\frac{1}{2}\%$ (U. S.) $= 4\frac{1}{2}\%$ (Mich. 6's).

NOTE.—When taxes on Michigan 6's are 2%, their net interest is 4%, which is $\frac{1}{2}\%$ less than the interest of U. S. $4\frac{1}{2}$'s. When taxes on Michigan 6's are $1\frac{1}{2}\%$, their net interest is $4\frac{1}{2}\%$, which equals the interest of U. S. $4\frac{1}{2}$'s.

31. (1) $\$100 \times .05 = \$5$, interest on \$100 bond at 5%;
$\$100 \times 1.20 = \$120$, cost of \$100 bond at 120;
$\$5 \div \$120 = .04\frac{1}{6}$, rate % of interest of 5% bonds on cost at 120;
$4\frac{1}{6}\% - 1\frac{1}{2}\% = 2\frac{2}{3}\%$, net rate % of int. on Mass. 5's;
$3\frac{1}{2}\% - 2\frac{2}{3}\% = \frac{5}{6}\%$, difference in rate % interest.

(2) $5000 \times .03\frac{1}{2} = \$175$, interest on U. S. $3\frac{1}{2}$'s;
$\$5000 \times .05 = \$250$, interest on Mass. 5's;
$\$5000 \times 1.20 \times .01\frac{1}{2} = \$90$, tax on \$5000 in Mass. 5's;
$\$250 - \$90 = \$160$, net income from Mass. 5's;
$\$175 - \$160 = \$15$, difference in net incomes.

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32. 16 mill tax $= .016$, or $1\frac{3}{5}\%$;
$6\% - 1\frac{3}{5}\% = 4\frac{2}{5}\%$, net interest on Mo. 6's;
$4\frac{2}{5}\%$ (Mo. 6's) $- 4\%$ (U. S.) $= \frac{2}{5}\%$, in favor Mo. 6's.

33. $\$100 \times 1.15 = \$115$, cost;
$\$5 \div \$115 = .04\frac{8}{23}$, rate % of int. U. S. 5's on cost;
$7\% - 2\% = 5\%$, net rate % of int. of Mich. 7's;
$\$100 \times 1.20 = \$120$, cost of \$100 Mich. 7's;
$\$5 \div \$120 = .04\frac{1}{6}$, net rate % of int. of Mich. 7's on cost;
$4\frac{8}{23}\% - 4\frac{1}{6}\% = \frac{25}{138}\%$, in favor of U. S. 5's.

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2. $\$1250 \times .00\frac{1}{2} = \$6.25$, discount;
$\$1250 - \$6.25 = \$1243.75$, cost.
Or, $\$1250 \times .99\frac{1}{2} = \$1243.75$, cost of draft.

3. $\$1050 \times 1.00\frac{1}{4} = \$1052.625$, cost of draft.

4. $\$2500 \times 1.01\frac{1}{2} = \$2537.50$, cost.

6. 63 da. $\therefore .0105$; $.0105 \times \frac{4}{3} = .014$ (at 8%);
$\$650 \times .014 = \$9.10$; $\$650 - \$9.10 = \$640.90$, pro.;
$\$650 \times .00\frac{1}{2} = \$3.25$, premium;
$\$640.90 + \$3.25 = \$644.15$, cost of draft.
Or, $\$1.00 + \$.00\frac{1}{2} - \$.014 = \$.991$, cost of \$1;
$\$650 \times .991 = \$644.15$, cost of draft.

7. 45 da. $\therefore .008$; $.008 \times \frac{7}{6} = .009\frac{1}{3}$ (at 7%);
$\$320 \times .009\frac{1}{3} = \$2.98\frac{2}{3}$, interest;
$\$320 - \$2.98\frac{2}{3} = \$317.01\frac{1}{3}$, proceeds;
$\$320 \times .00\frac{3}{4} = \$2.40$, discount;
$\$317.01\frac{1}{3} - \$2.40 = \$314.61\frac{1}{3}$, cost.

Or, $\$1 - .009\frac{1}{3} - .00\frac{3}{4} = \$.983\frac{1}{3}$, cost of \$1;
$\$320 \times .983\frac{1}{3} = \$314.613\frac{1}{3}$, cost.

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9. $100\% - 1\frac{3}{4}\% = 98\frac{1}{4}\%$;
$\$962.85 \div .98\frac{1}{4} = \$980$, face of draft.
Or, $\$1.00 - \$.01\frac{3}{4} = \$.98\frac{1}{4}$, cost of \$1;
$\$962.85 \div \$.98\frac{1}{4} = 980$, number of dollars in draft.
10. $\$1256.25 \div 1.005 = \$1250$, face of draft.
11. $\$4681.25 \div .98\frac{3}{4} = \$4740.506+$, face of draft.
13. 63 da. $\therefore$.0105; $.0105 \times \frac{4}{5} = .014$ (at 8%);
$\$1. - \$.014 + \$.0125 = \$.9985$, cost of \$1;
$\$798.80 \div .9985 = \$800$, face of draft.
14. 33 da. $\therefore$.0055;
$\$1. - \$.0055 - \$.015 = \$.9795$, cost of \$1;
$\$352.62 \div .9795 = \$360$, face of draft.
15. $\$4750 \times .03 = \$142.50$; $\$4750 - \$142.50 = \$4607.50$;
63 da. $\therefore$.0105; $0105 \times \frac{10}{6} = .0175$ (at 10%);
$\$1 - \$.0175 + \$.0075 = \$.99$, cost of \$1;
$\$4607.50 \div .99 = \$4654.04+$, face of draft.

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2. £219 10s. 6d. = £219.525;
$\$4.91\frac{1}{3} \times 219.525 = \$1078.111\frac{2}{3}$, cost.
3. £200 12s. = £200.6; $\$4.856 \times 200.6 = \$974.1136$.
4. £300 8s. = £300.4; $\$4.88 \times 300.4 = \$1465.952$.
5. $\$4.86 \times 250 = \$1215$; $\$1215 \times .00\frac{1}{3} = \$1.518\frac{3}{4}$;
$\$1215 + \$1.518\frac{3}{4} = \$1216.518\frac{3}{4}$, total cost.
7. $\$2195.475 \div \$4.86\frac{2}{3} = 451.125$, number of £;
£451.125 = £451 2s. 6d., face of bill.
8. $\$1174.20 \div \$4.89\frac{1}{4} = 240$, number of £ in bill.

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10. 6475 fr. $\div$ 5.18 fr. = 1250; $\$1 \times 1250 = \$1250$, cost.
11. 5330 fr. $\div$ 5.125 fr. = 1040; $\$1 \times 1040 = \$1040$, cost.

13. $5.16\frac{2}{3}$ fr. $\times$ 2432 = 12565$\frac{1}{3}$ fr., face of bill.

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14. 6418$\frac{3}{4}$ fr. $\div$ 5.13$\frac{1}{2}$ fr. = 1250;
\$1 $\times$ 1250 = \$1250, cost.

15. (1) 5.12$\frac{1}{2}$ fr. $\times$ 650 = 3331$\frac{1}{4}$ fr., face of bill.
(2) 5.15 fr. $\times$ 650 = 3347$\frac{1}{2}$ fr., face of bill.

17. \$.96$\frac{1}{2}$ $\times$ 1680 $\div$ 4 = \$405.30, cost of bill.

18. \$.96$\frac{1}{8}$ $\times$ 3200 $\div$ 4 = \$769, cost of bill.

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20. (\$324 $\div$ \$.94$\frac{1}{2}$) $\times$ 4 = 1371$\frac{3}{7}$, marks in bill.

21. (1) \$.95$\frac{3}{4}$ $\times$ 960 $\div$ 4 = \$229.80, cost of bill.
(2) \$.95$\frac{1}{2}$ $\times$ 960 $\div$ 4 = \$229.20, cost of bill.

22. (\$514.35 $\div$ \$.95$\frac{1}{4}$), $\times$ 4 = 2160, marks in bill.

23. (\$240 $\div$ \$.96$\frac{1}{4}$), $\times$ 4 = 997$\frac{3}{77}$, marks in bill.

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2. \$200 $\times$ 4 = \$800
\$600 $\times$ 8 = \$4800
\$800)\$5600(7, number of months.
The equated time is 7 months after date.

3. \$ 300 + \$400 = \$700
\$1200 — \$700 = \$500
\$300 $\times$ 4 = \$1200
\$400 $\times$ 6 = \$2400
\$500 $\times$ 12 = \$6000
\$1200)\$9600(8, number of months.
The equated time is 8 months after date.

4. \$800 $\times$ $\frac{1}{8}$ = \$100; \$100 $\times$ 2 = \$ 200
\$800 $\times$ $\frac{1}{2}$ = \$400; \$400 $\times$ 3 = \$1200
\$800 $\times$ $\frac{3}{8}$ = \$300; \$300 $\times$ 6 = \$1800
\$800)\$3200(4, no. of mo.
The equated time is 4 months after date.

5. $300 × 4 = $1200
$600 × 5 = $3000
$700 × 10 = $7000
$1600) $11200(7, number of months.
The equated time is 7 months after date.

6. $500 × 4 = $2000
700 × 6 = 4200
1000 × 5 = 5000
$2200) $11200($5\frac{1}{11}$, number of months.
The equated time is $5\frac{1}{11}$ months after purchase.

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7. $500 × 0 = $500
400 × 3 = $1200
500 × 4 = 2000
600 × 8 = 4800
$2000) $8000(4, number of months.
The equated time is 4 months after purchase.

9. $220 × .005 = $1.10, interest for 30 days;
$300 × .006$\frac{2}{3}$ = $2.00, interest for 40 days;
$250 × .01 = $2.50, interest for 60 days;
$100 × .015 = $1.50, interest for 90 days.
$870 × .000$\frac{1}{6}$ = $.145) $7.10($48\frac{2}{29}$, number of days.
The equated time is 49 days after date.

10. $520 × .007$\frac{1}{2}$ = $3.90, interest for 45 days;
$340 × .01 = $3.40, interest for 60 days;
$640 × .015 = $9.60, interest for 90 days.
$1500 × .000$\frac{1}{6}$ = $.25) $16.90($67\frac{2}{5}$, number of days.
The equated time is 68 days after date.

11. $375 × 0 = $0., interest for 0 days;
$425 × .005 = $2.125, interest for 30 days;
$500 × .01 = $5.00, interest for 60 days;
$600 × .0125 = $7.50, interest for 75 days.
$1900 × .000$\frac{1}{6}$ = $.31$\frac{2}{3}$) $14.625($46\frac{7}{38}$, no. of days.
The equated time is 46 days after date.

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12. \$340

\$450 × .005$\frac{1}{6}$ = \$2.325, interest for 31 days;
\$560 × .011 = \$6.16, interest for 66 days;
\$650 × .015$\frac{1}{3}$ = \$9.966$\frac{2}{3}$, interest for 92 days.

\$2000 × .000$\frac{1}{6}$ = \$.33$\frac{1}{3}$) \$18.451$\frac{2}{3}$ (55.355, no. of days.

The equated time is 55 days from May 10, 1880, which is July 4, 1880.

13. \$1000

\$850 × .005 = \$4.25, int. for 30 days;
\$750 × .015$\frac{1}{3}$ = \$11.50, int. for 92 days;
\$900 × .020$\frac{1}{3}$ = \$18.30, int. for 122 days.

\$3500 × .000$\frac{1}{6}$ = \$.58$\frac{1}{3}$) \$34.05 (58$\frac{13}{35}$, no. of days.

The equated time is 58 days from June 1, 1880, which is July 29, 1880.

14. \$75

\$115 × .00$\frac{1}{3}$ = \$.383$\frac{1}{3}$, int. for 20 days;
\$220 × .008$\frac{1}{3}$ = \$1.833$\frac{1}{3}$, int. for 50 days;
\$315 × .011$\frac{5}{6}$ = \$3.727$\frac{1}{2}$, int. for 71 days;
\$350 × .014$\frac{1}{6}$ = \$4.958$\frac{1}{3}$, int. for 85 days;

\$1075 × .000$\frac{1}{6}$ = \$.179$\frac{1}{6}$) \$10.902$\frac{1}{2}$ (60.8+, no. of days.

The equated time is 61 days from May 6, 1880, which is July 6, 1880.

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17. \$200 × 3 = \$600;
\$300 − \$200 = \$100;
\$600 ÷ \$100 = 6, no. of months after maturity.

The time for the payment of the balance (\$100) is 6 months *after maturity.*

18. \$ 50 × 6 = \$300;
\$150 — \$50 = \$100;
\$300 ÷ \$100 = 3, no. of months after maturity.

The time for the payment of the balance (\$100) is 3 months after maturity.

19. \$600 × 6 = \$3600
\$600 × 3 = \$1800
6 (mo.) + 3 (mo.) = 9)\$1800(\$200, balance to run 9 mo.
\$600 — \$200 = \$400, payment to be made in 3 mo.

EXPLANATION.—A is entitled to the use of \$600 for 6 months, or \$3600 for 1 month, and he has the use of \$600 for 3 months, or \$1800 for 1 month, and hence is entitled to the use of \$1800 more for 1 month, or $\frac{1}{9}$ of \$1800, which is \$200, for 9 months. Hence, at the end of 3 months, A must pay \$600 — \$200, or \$400, to extend the time for the payment of the balance 6 months, which is 9 months after the date of the first payment.

20. \$400 × 8 = \$3200
\$300 × 6 = \$1800
\$200 × 4 = \$ 800
\$1500 — \$900 = \$600)\$5800(9⅔, number of months.

The balance (\$600) is due 9⅔ months, or 9 mo. 20 da., after maturity of debt.

21. \$450 × 94 = \$42300
\$200 × 71 = \$14200
\$250 × 51 = \$12750
\$350 × 30 = \$10500
\$250 × 15 = \$ 3750
\$2500 — \$1500 = \$1000)\$83500(83½, number of days.

The equated time for the payment of the balance (\$1000) is 83 days forward from July 10, 1880, the date of maturity, which is Oct. 1, 1880.

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23. Due July 15, 1879, $400
" Sept. 20, " $245 × 67 = $16415
" Oct. 25, " $375 × 102 = $38250
" Dec. 15, " $625 × 153 = $95625
$1645)$150290(91.3

The equated time of maturity is 91 days forward from July 15, 1879, which is October 14, 1879.

24. Due Sept. 9, 1880, $340
" Oct. 6, " $530 × 27 = $14310
" Oct. 8, " $213 × 29 = $ 6177
" Dec. 30, " $150 × 112 = $16800
$1233)$37287(30.2

The equated time is 30 days forward from September 9, 1880, which is October 9, 1880.

(2) 58 da. ∴ .009⅔; $1233 × 1.009⅔ = $1244.919.

EXPLANATION.—On December 6, 1880, there would be due the amount of the bill, $1233, and the interest on the same from October 9, 1880 (the equated time of maturity), to December 6, 1880, or for 58 days. The decimal multiplier for interest for 58 days at 6% is .009⅔, and the decimal multiplier for the amount is 1.009⅔.

25. Due June 3, 1883, $250
" Aug. 15, " $180 × 73 = $13140
" Sept. 20, " $325 × 109 = $35425
" Nov. 10, " $ 80 × 160 = $12800
" Jan. 1, 1884, $100 × 212 = $21200
$935)$82565(88.3

The equated time is 88 days forward from June 3, 1883, which is August 30, 1883.

(2) 93 da. ∴ .015½; $935 × 1.015½ = $949.49¼.

ANALYSIS.

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1. If the cost of $\frac{7}{8}$ yd. is $\$\frac{21}{25}$, the cost of $\frac{1}{8}$ yd. is $\frac{1}{7}$ of $\$\frac{21}{25}$, or $\$\frac{3}{25}$, and the cost of $\frac{8}{8}$ yd., or 1 yd., is 8 times $\$\frac{3}{25}$, which is $\$\frac{24}{25}$; and hence the cost of $\frac{5}{8}$ yd. is $\frac{5}{8}$ of $\$\frac{24}{25}$; $\frac{1}{8}$ of $\$\frac{24}{25}$ is $\$\frac{4}{25}$, and $\frac{5}{8}$ of it is 5 times $\$\frac{4}{25}$, which is $\$\frac{20}{25}$, or $\$\frac{4}{5}$.

2. If the cost of $\frac{3}{4}$ bbl. is $\$5\frac{1}{4}$, the cost of $\frac{1}{4}$ bbl. is $\frac{1}{3}$ of $\$\frac{21}{4}$, or $\$\frac{7}{4}$, and the cost of $\frac{4}{4}$ bbl. is 4 times $\$\frac{7}{4}$, which is $7; and hence the cost of $\frac{5}{7}$ bbl. is $\frac{5}{7}$ of $7; $\frac{1}{7}$ of $7 is $1, and $\frac{5}{7}$ of it is 5 times $1, which is $5.

3. If the cost of $\frac{3}{4}$ lb. is 15 cts., the cost of $\frac{1}{4}$ lb. is $\frac{1}{3}$ of 15 cts., or 5 cts., and the cost of $\frac{4}{4}$ lb. is 4 times 5 cts., which is 20 cts.; the cost of $3\frac{1}{2}$ lb. is $3\frac{1}{2}$ times 20 cts., which is 70 cts.

4. If $\frac{4}{5}$ of the cost is $120, $\frac{1}{5}$ of it is $\frac{1}{4}$ of $120, or $30, and $\frac{5}{5}$ of cost is 5 times $30, which is $150, the cost.

5. If $\frac{4}{4}$ plus $\frac{1}{4}$ of cost, or $\frac{5}{4}$ of cost, equals $90, $\frac{1}{4}$ of cost is $\frac{1}{5}$ of $90, or $18, and $\frac{4}{4}$ of cost is 4 times $18, which is $72, the cost.

6. $\frac{5}{5}$ less $\frac{2}{5}$ is $\frac{3}{5}$; if $\frac{3}{5}$ of length is 30 yd., $\frac{1}{5}$ of length is $\frac{1}{3}$ of 30 yd., or 10 yd., and $\frac{5}{5}$ of length is 5 times 10 yd., which is 50 yd., length of flannel before fulling.

7. $\frac{3}{5} + \frac{3}{8} = \frac{24}{40} + \frac{15}{40} = \frac{39}{40}$, part of money in purse and hand; $\frac{40}{40} - \frac{39}{40} = \frac{1}{40}$, part of money in pocket; if $\frac{1}{40}$ of money = 25 cts., $\frac{40}{40}$ of it = 40 times 25 cts. = 1000 cts. = $10, amount of money.

8. $\frac{2}{8}$ of $\$\frac{3}{5} = \$\frac{2}{5}$, money given to John; $\$\frac{3}{5} - \$\frac{2}{5} = \$\frac{1}{5}$, money then owned by boy; $\frac{1}{2}$ of $\$\frac{1}{5} = \$\frac{1}{10}$, money given to James.

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9. $\frac{3}{5} - \frac{2}{5} = \frac{1}{5}$, part of sheep left; $\frac{3}{5}$ of $\frac{1}{3} = \frac{1}{5}$, part of sheep bought; $\frac{1}{3} + \frac{1}{5} = \frac{5}{15} + \frac{3}{15} = \frac{8}{15}$, part of sheep equal to 40 sheep; if $\frac{8}{15}$ of sheep = 40 sheep, $\frac{1}{15} = \frac{1}{8}$ of 40 sheep = 5 sheep, and $\frac{15}{15}$ of sheep = 15 times 5 sheep = 75 sheep, number of sheep at first.

10. $\frac{5}{5} - \frac{2}{5} = \frac{3}{5}$; $\frac{1}{3}$ of $\frac{3}{5} = \frac{1}{5}$, part of money spent; $\frac{3}{5} - \frac{1}{5} = \frac{2}{5}$, part of money equal to 10 cts.; if $\frac{2}{5}$ of his money = 10 cts., $\frac{1}{5}$ of it = 5 cts., and $\frac{5}{5}$ of it = 25 cts.

11. $\frac{1}{4}$ of $\frac{3}{4}$ is $\frac{3}{16}$; if $\frac{3}{16}$ of cost is \$60, $\frac{1}{16}$ of cost is \$20, and $\frac{5}{5}$ of cost is \$100.

NOTE.—When pupils are sufficiently familiar with the steps of analysis, they may be taught to give results without orally stating each step, as is done in the above solutions to problem 10 inclusive.

12. $\frac{3}{8} + \frac{5}{8} = \frac{13}{8}$, part of cost for which horse was sold; if $\frac{13}{8}$ of cost = \$130, $\frac{1}{8}$ of cost = \$10, and $\frac{8}{8}$ of cost = \$80, cost of horse.

13. If a staff 5 ft. long cast a shadow 2 ft. long, 1 ft. of shadow requires $2\frac{1}{2}$ ft. of substance, and hence 80 ft. of shadow will require 80 times $2\frac{1}{2}$ ft. of substance, or 200 ft. of substance: the steeple is 200 ft. high.

Or, if a staff 5 ft. long casts a shadow 2 ft. long, it will require as many times 5 ft. of height of steeple as 2 ft. are contained times in 80 ft., which is 40; 40 times 5 ft. = 200 ft.

Or, since 2 is $\frac{2}{5}$ of 5, the length of shadow is $\frac{2}{5}$ of the height of the substance that casts it, and hence 80 ft. length of the shadow is $\frac{2}{5}$ of the height of the steeple; if $\frac{2}{5}$ of the height of the steeple is 80 ft., $\frac{1}{5}$ of it is 40 ft., and $\frac{5}{5}$ of it, 5 times 40 ft., which is 200 ft.

14. If a staff 3 ft. long casts a shadow 2 ft. long, the length of the shadow is $\frac{2}{3}$ of the height of the substance that casts it, and hence the length of the shadow of a *steeple* 90 ft. high is $\frac{2}{3}$ of 90 ft., which is 60 ft.

15. If a steeple 200 ft. high cast a shadow 150 ft. long, the length of the shadow is $\frac{150}{200}$, or $\frac{3}{4}$ of the height of the steeple, and hence 80 ft., the length of the pole's shadow, is $\frac{3}{4}$ of the height of the pole; if 80 ft. is $\frac{3}{4}$ of the height of the pole, $\frac{1}{4}$ of it is $26\frac{2}{3}$ ft., and $\frac{4}{4}$, or the pole, is $106\frac{2}{3}$ ft.

Or, since 200 is $\frac{200}{150}$, or $\frac{4}{3}$ of 150, the height of the steeple is $\frac{4}{3}$ of the length of its shadow, and hence the height of the pole is $\frac{4}{3}$ of the length of its shadow, or $\frac{4}{3}$ of 80 ft., which is $106\frac{2}{3}$ ft.

16. If it take 5 men 12 days to do the work, it will take 1 man 5 times 12 days, which is 60 days, and it will take 6 men $\frac{1}{6}$ of 60 days, which is 10 days.

17. If 8 men can do the work in 15 days, 1 man can do it in 8 times 15 days, which is 120 days, and it will take as many men to do it in 10 days as 10 days are contained times in 120 days, which is 12: it will take 12 men 10 days to do the work.

Or, if 8 men can do the work in 15 days, it will require 15 times 8 men, which is 120 men, to do it in 1 day, and to do it in 10 days it will take $\frac{1}{10}$ of 120 men, which is 12 men.

18. If 9 men can do the work in $4\frac{2}{3}$ days, 1 man can do it in 9 times $4\frac{2}{3}$ days, which is 42 days, and 7 men can do it in $\frac{1}{7}$ of 42 days, which is 6 days.

19. If 3 pipes can empty a cistern in 30 minutes, 1 pipe can empty it in 3 times 30 minutes, which are 90 minutes, and it will take as many pipes to empty it in 10 minutes, as 10 minutes are contained times in 90 minutes, which is 9: it will take 9 pipes to empty it in 10 minutes.

Or, if 3 pipes can empty a cistern in 30 minutes, it will take 30 times 3 pipes, or 90 pipes, to empty it in 1 minute, and $\frac{1}{10}$ of 90 pipes, or 9 pipes, to empty it in 10 minutes.

20. If it require 12 days of 10 hours, to do the work,

it will require 12 times 10 hours, or 120 hours, and it will require as many days of 8 hours each, as 8 hours are contained times in 120 hours, which is 15: it will require 15 days of 8 hours each.

Or, if it require 12 days of 10 hours each, it will require 10 times 12 days, or 120 days of 1 hour each, and it will require $\frac{1}{8}$ of 120 days, or 15 days of 8 hours each.

21. If a loaf weigh 10 ounces when flour is \$4 a barrel, it should weigh 4 times 10 ounces, or 40 ounces, when flour is \$1 a barrel, and, when flour is \$5 a barrel, it should weigh $\frac{1}{5}$ of 40 ounces, which is 8 ounces.

22. Since the provisions will supply 20 men 12 days, they will supply 1 man 20 times 12 days, which is 240 days; if 12 men leave, 8 men will remain, and the provisions will supply the 8 men $\frac{1}{8}$ of 240 days, which is 30 days.

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23. If a horse eat 2 bu. in 6 days, it will eat 1 bu. in $\frac{1}{2}$ of 6 days, which is 3 days, and 2 horses will eat 1 bu. in $\frac{1}{2}$ of 3 days, which is $1\frac{1}{2}$ days, and hence they will eat 18 bu. in 18 times $1\frac{1}{2}$ days, which is 27 days.

24. If 3 men can mow 18 acres in 4 days, 1 man can mow $\frac{1}{3}$ of 18 acres, or 6 acres, in 4 days, and $\frac{1}{4}$ of 6 acres, which is $1\frac{1}{2}$ acres, in 1 day, and in 3 days 1 man can mow 3 times $1\frac{1}{2}$ acres, or $4\frac{1}{2}$ acres; and hence it will take as many men to mow 9 acres in the same time as $4\frac{1}{2}$ acres are contained times in 9 acres, which is 2: it will take 2 men to mow 9 acres in 3 days.

25. If the provisions will supply 15 men 20 days, they will supply 1 man 15 times 20 days, or 300 days, and hence they will supply 50 men $\frac{1}{50}$ of 300 days, which is 6 days.

26. If 5 men can do $\frac{3}{5}$ of a piece of work in a day, 1 *man can* do $\frac{1}{5}$ of $\frac{3}{5}$, or $\frac{3}{25}$ of it, in a day, and it will take

1 man as many days to do the entire work as $\frac{8}{40}$ is contained times in $\frac{40}{40}$, which is $13\frac{1}{3}$: it will take 1 man $13\frac{1}{3}$ days to do the entire work.

27. If 8 men can do $\frac{3}{4}$ of the work in 3 days, 1 man can do $\frac{1}{8}$ of $\frac{3}{4}$, or $\frac{3}{32}$, of it in 3 days, and $\frac{1}{3}$ of $\frac{3}{32}$, or $\frac{1}{32}$, of it in 1 day, and 4 men can do 4 times $\frac{1}{32}$, or $\frac{1}{8}$, of it in 1 day; and hence it will take 4 men as many days to do the work as $\frac{1}{8}$ is contained times in $\frac{8}{8}$, which is 8.

28. If 20 men earn \$120 in 4 days, 1 man in 4 days will earn $\frac{1}{20}$ of \$120, which is \$6, and in 1 day $\frac{1}{4}$ of \$6, which is $\$1\frac{1}{2}$; if 1 man earn $\$1\frac{1}{2}$ in a day, 5 men will earn 5 times $\$1\frac{1}{2}$, which is $\$7\frac{1}{2}$, in a day, and in 8 days they will earn 8 times $\$7\frac{1}{2}$, which is \$60.

29. If 5 horses eat 40 bu. in 3 weeks, 1 horse will eat $\frac{1}{5}$ of 40 bu., which is 8 bu., in 3 weeks, and $\frac{1}{3}$ of 8 bu., which is $2\frac{2}{3}$ bu., in 1 week; and hence 12 horses will eat in 1 week 12 times $2\frac{2}{3}$ bu., which is 32 bu., and in 10 weeks 10 times 32 bu., which is 320 bu.

30. If 8 men can dig 40 rods of ditch in 6 days, 1 man can dig $\frac{1}{8}$ of 40 rods, or 5 rods, in 6 days, and $\frac{1}{6}$ of 5 rods, or $\frac{5}{6}$ of a rod, in 1 day, and 12 men can dig 12 times $\frac{5}{6}$ of a rod, which is 10 rods, in 1 day; if 12 men can dig 10 rods a day, it will take as many days to dig 60 rods as 10 is contained times in 60, which is 6: it will take 12 men 6 days to dig 60 rods of ditch.

31. If the interest of \$50 for 9 months be \$6, the interest of \$150 (3 times \$50) for 9 months will be 3 times \$6, which is \$18, and for 18 months (2 times 9 months) the interest of \$150 will be twice \$18, which is \$36.

32. If the number of boys equal $\frac{4}{5}$ of the number of girls, the number of pupils equals $\frac{5}{5} + \frac{4}{5}$, or $\frac{9}{5}$, of the number of girls; if $\frac{9}{5}$ of the number of girls is 180, $\frac{1}{5}$ of the number is $\frac{1}{9}$ of 180, which is 20, and $\frac{5}{5}$ of it is 5 times 20, which is 100: hence the school enrolls 100 girls, and $\frac{4}{5}$ of 100, or 80, boys.

33. If the cost of chain is $\frac{5}{8}$ of cost of watch, the cost of both is $\frac{8}{8} + \frac{5}{8}$, or $\frac{13}{8}$, of cost of watch; if $\frac{13}{8}$ of cost of watch is \$130, $\frac{1}{8}$ of its cost is $\frac{1}{13}$ of \$130, which is \$10, and $\frac{8}{8}$, or its cost, is 8 times \$10, which is \$80; and the cost of the chain is $\frac{5}{8}$ of \$80, which is \$50.

34. If the chain cost $\frac{1}{3}$ of the cost of the watch, the cost of watch and chain was $\frac{3}{3} + \frac{1}{3}$, or $\frac{4}{3}$, of the cost of the watch; since $\frac{4}{3}$ of cost of watch was \$80, $\frac{1}{3}$ of its cost was $\frac{1}{4}$ of \$80, which is \$20, and $\frac{3}{3}$, or its cost, was 3 times \$20, which is \$60, and the cost of the chain was $\frac{1}{3}$ of \$60, which is \$20.

35. If A has $1\frac{1}{2}$ times as many cents as B, A and B together have $\frac{2}{2} + \frac{3}{2}$, or $\frac{5}{2}$, times as many cents as B, and hence $\frac{5}{2}$ of B's money is 40 cents; if $\frac{5}{2}$ of it is 40 cents, $\frac{1}{2}$ of it is 8 cents and $\frac{2}{2}$ of it is 16 cents: hence B has 16 cents and A $1\frac{1}{2}$ times 16 cents, which is 24 cents.

36. If $\frac{3}{5}$ of the longer part equals the shorter, the length of both parts equals $\frac{5}{5} + \frac{3}{5}$, or $\frac{8}{5}$, of the longer part, and hence $\frac{8}{5}$ of the longer part equals 120 feet; if $\frac{8}{5}$ of the longer part equals 120 feet, $\frac{1}{5}$ of it is 15 feet, and $\frac{5}{5}$ of it is 5 times 15 feet, which is 75 feet; and the shorter part is $\frac{3}{5}$ of 75 feet, which is 45 feet.

37. If $\frac{5}{7}$ of the shorter part equal $\frac{5}{7}$ of the longer part, $\frac{1}{7}$ of the shorter equals $\frac{1}{7}$ of the longer, and $\frac{5}{7}$, or the whole of the shorter, equals $\frac{5}{7}$ of the longer; and hence $\frac{7}{7}$ plus $\frac{5}{7}$, or $\frac{12}{7}$, of the longer part equals 120 feet; if $\frac{12}{7}$ of it equals 120 feet, $\frac{1}{7}$ of it equals 10 feet, and $\frac{7}{7}$ of it equals 70 feet: if the longer part is 70 feet, the shorter is $\frac{5}{7}$ of 70 feet, which is 50 feet.

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38. If $\frac{3}{8}$ of the time past noon equaled the time to midnight, $\frac{3}{8}$ plus $\frac{3}{8}$, or $\frac{6}{8}$, of the time past noon equaled the whole time from noon to midnight, or 12 hours; *if* $\frac{6}{8}$ *of the* time past noon was 12 hours, $\frac{1}{8}$ of it was $\frac{1}{8}$

of 12 hours, or $2\frac{2}{3}$ hours, and $\frac{3}{8}$, or the time past noon, was 3 times $2\frac{2}{3}$ hours, which is $7\frac{1}{3}$ hours, or 7 hours and 12 minutes: the time of day was 12 minutes past 7 P. M.

Or, if $\frac{2}{3}$ t. past n. = t. to m., $\frac{3}{8}$ t. past n. + $\frac{2}{3}$ t. past n. = 12 hours; if $\frac{8}{3}$ t. past n. = 12 hours, $\frac{1}{3}$ t. past n. = $2\frac{2}{3}$ hours, and t. past n. = $7\frac{1}{3}$ hours: hence the time of day was 7 hours 12 minutes past noon, or 12 minutes past 7 P. M.

39. If $\frac{3}{4}$ of time past noon equals $\frac{3}{8}$ of time to midnight, $\frac{1}{4}$ of time past noon equals $\frac{1}{8}$ of time to midnight, and $\frac{4}{4}$, or time past noon, equals $\frac{4}{8}$, or $\frac{1}{2}$ of time to midnight, and hence $\frac{3}{2}$ plus $\frac{1}{2}$ of time to midnight equals 12 hours; if $\frac{3}{2}$ of time to midnight equals 12 hours, $\frac{1}{2}$ of time to midnight equals 4 hours, and the time to midnight equals 8 hours; the time past noon equals $\frac{1}{2}$ of 8 hours, or 4 hours, and hence the hour of day is 4 P. M.

Or, if $\frac{3}{4}$ t. past n. = $\frac{3}{8}$ t. to m., $\frac{1}{4}$ t. past n. = $\frac{1}{8}$ t. to m., and t. past n. = $\frac{1}{2}$ t. to m.; and hence $\frac{3}{2}$ t. to m. + $\frac{1}{2}$ t. to m. = 12 hours; if $\frac{3}{2}$ t. to m. = 12 hours, $\frac{1}{2}$ t. to m. = 4 hours, and t. to m. = 8 hours, and t. past n. = $\frac{1}{2}$ of 8 hours, or 4 hours: hence the time of day is 4 P. M.

40. If $\frac{2}{3}$ t. to n. = $\frac{2}{5}$ t. past m., $\frac{1}{3}$ t. to n. = $\frac{1}{5}$ t. past m., and t. to n. = $\frac{3}{5}$ t. past m., and hence $\frac{5}{5}$ t. past m. + $\frac{3}{5}$ t. past m. = 12 hours; if $\frac{8}{5}$ t. past m. = 12 hours, $\frac{1}{5}$ t. past m. = $1\frac{1}{2}$ hours, and t. past m. = $7\frac{1}{2}$ hours: hence the time of day is 7 o'clock 30 minutes A. M.

41. The difference between $\frac{2}{3}$ of his present age and $\frac{7}{9}$ of it is $\frac{2}{9}$ of his present age, which equals 10 years; if $\frac{2}{9}$ of his present age is 10 years, $\frac{1}{9}$ of it is 5 years, and his present age is 9 times 5 years, which is 45 years.

42. $\frac{5}{5}$ of the father's age plus $\frac{3}{5}$ of his age is $\frac{8}{5}$ of his age; if $\frac{8}{5}$ of the father's age is 80 years, $\frac{1}{5}$ of it is 10 years, and $\frac{5}{5}$ of it, or his age, is 50 years; the son's age is $\frac{3}{5}$ of 50 years, which is 30 years.

43. If to my age you add its half and its third the sum will be $\frac{6}{6} + \frac{3}{6} + \frac{2}{6}$, or $\frac{11}{6}$, of my age; if $\frac{11}{6}$ of my

age plus 28 years equals $\frac{18}{6}$ of my age; $\frac{18}{6}$ of it less $\frac{11}{6}$ of it, which is $\frac{7}{6}$ of it, equals 28 years; if $\frac{7}{6}$ of my age is 28 years, $\frac{1}{6}$ of it is 4 years, and my age is 24 years.

44. If $\frac{3}{4}$ of A's age is $\frac{4}{7}$ of B's, $\frac{1}{4}$ of A's age is $\frac{4}{21}$ of B's, and A's age is $\frac{16}{21}$ of B's, and the difference in their ages is $\frac{21}{21}$ less $\frac{16}{21}$, or $\frac{5}{21}$ of B's age; if $\frac{5}{21}$ of B's age is 10 years, $\frac{1}{21}$ of it is 2 years, and B's age is 42 years; A's age is $\frac{16}{21}$ of 42 years, which is 32 years.

45. $\frac{8}{10}$ of \$90 is \$27 and $\frac{3}{5}$ of 3 times the cost of the saddle is $\frac{8}{5}$ of its cost; if $\frac{8}{5}$ of the cost of the saddle is \$27, $\frac{1}{5}$ of its cost is \$3, and $\frac{5}{5}$, or its cost, is \$15.

46. If $\frac{2}{3}$ of cost of carriage equals $\frac{2}{3}$ of the cost of the horse, $\frac{1}{3}$ of the cost of carriage equals $\frac{1}{3}$ of the cost of horse, and the cost of the carriage equals $\frac{3}{3}$ of the cost of the horse, and hence $\frac{8}{3}$ plus $\frac{3}{3}$, or $\frac{11}{3}$, of the cost of the horse equals \$280; if $\frac{8}{3}$ of the cost of horse equals \$280, $\frac{1}{3}$ of its cost is \$35, and its cost is \$105; the cost of the carriage is $\frac{3}{3}$ of \$105, which is \$175.

47. Since the cost of bridle was $\frac{1}{2}$ of the cost of saddle, which was $\frac{1}{6}$ of the cost of the horse, the cost of the bridle was $\frac{1}{2}$ of $\frac{1}{6}$, or $\frac{1}{12}$, of the cost of the horse, and hence cost of horse plus $\frac{1}{6}$ of its cost plus $\frac{1}{12}$ of its cost, or $\frac{15}{12}$ of its cost, was \$150; if $\frac{15}{12}$, or $\frac{5}{4}$, of the cost of the horse was \$150, $\frac{1}{4}$ of its cost was \$30, and its cost was \$120; the cost of the saddle was $\frac{1}{6}$ of \$120, which is \$20, and the cost of the bridle was $\frac{1}{12}$ of \$120, which is \$10.

48. Since the elder son earned twice as much as the younger son, and the father earned twice as much as the elder, the father earned four times as much as the younger son, and hence the younger son's wages plus 2 times his wages plus 4 times his wages, or 7 times his wages, equaled \$140; if 7 times his wages were \$140, the younger son earned \$20; the elder son, twice \$20, or \$40; and the father, 4 times \$20, or \$80.

Or, since $\frac{1}{2}$ of the father's wages equaled the elder son's, and $\frac{1}{2}$ of $\frac{1}{2}$, or $\frac{1}{4}$, of the father's wages equaled the

younger sons, the father's wages plus $\frac{1}{2}$ of his wages plus $\frac{1}{4}$ of his wages, or $\frac{7}{4}$ of his wages, equaled \$140, and his wages were \$80; the elder son's wages equaled $\frac{1}{2}$ of \$80, or \$40; and the younger son's, $\frac{1}{4}$ of \$80, or \$20.

49. 3 cows plus 5 cows are 8 cows, and since 3 is $\frac{3}{8}$ of 8, and 5 is $\frac{5}{8}$ of 8, the one that put in 3 cows should pay $\frac{3}{8}$ of \$40, which is \$15, and the one that put in 5 cows should pay $\frac{5}{8}$ of \$40, which is \$25.

50. If 4 sheep eat as much as 1 cow, 40 sheep will eat as much as 10 cows, and 40 sheep and 8 cows will together eat as much as 10 cows plus 8 cows, or 18 cows, and hence A should pay $\frac{10}{18}$, or $\frac{5}{9}$, of \$72, which is \$40, and B should pay $\frac{8}{18}$, or $\frac{4}{9}$, of \$72, which is \$32.

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51. If A has $1\frac{2}{3}$, or $\frac{5}{3}$ times as many sheep as B, both have $\frac{3}{3}$ plus $\frac{5}{3}$, or $\frac{8}{3}$, times as many as B, and hence $\frac{8}{3}$ of B's number of sheep equals 824 sheep; if $\frac{8}{3}$ of B's number of sheep is 824 sheep, $\frac{1}{3}$ of it is 103, and B's number of sheep is 309, and A's is $\frac{5}{3}$ of 309, which is 515.

52. If B pays $\frac{1}{2}$ as much as A, and C $\frac{1}{2}$ as much as B, C pays $\frac{1}{2}$ of $\frac{1}{2}$, or $\frac{1}{4}$, as much as A, and hence A's share plus $\frac{1}{2}$ of A's share plus $\frac{1}{4}$ of A's share, or $\frac{7}{4}$ of A's share, equals \$42; if $\frac{7}{4}$ of A's share is \$42, $\frac{1}{4}$ of it is \$6, and A's share is \$24; B's is $\frac{1}{2}$ of \$24, which is \$12; and C's $\frac{1}{2}$ of \$12, which is \$6.

53. If A owns $\frac{3}{4}$ as much as B, the difference is $\frac{1}{4}$ of B's part less $\frac{3}{4}$ of B's, which is $\frac{1}{4}$ of B's, and hence $\frac{1}{4}$ of B's part of farm is 40 acres, and his part is 160 acres; A's part is $\frac{3}{4}$ of 160 acres, which is 120 acres.

54. Since C's money is \$81, $\frac{3}{3}$ of C's money is $\frac{3}{3}$ of \$81, which is \$54, and since \$54 is $\frac{3}{4}$ of B's money, $\frac{1}{4}$ of B's is $\frac{1}{3}$ of \$54, or \$18, and $\frac{4}{4}$ of B's is \$72; since $\frac{3}{4}$ of

A's money equals $\frac{2}{5}$ of B's, $\frac{3}{4}$ of A's is $\frac{2}{5}$ of \$72, which is \$48; and if $\frac{3}{4}$ of A's is \$48, $\frac{1}{4}$ of it is $\frac{1}{3}$ of \$48, or \$16, and $\frac{4}{4}$ of it, or A's money, is 4 times \$16, which is \$64: hence A has \$64, and B \$72.

55. If 1 man can reap $\frac{3}{4}$ of an acre in 1 day, 6 men can reap 6 times $\frac{3}{4}$, or $4\frac{1}{2}$ acres, in 1 day, and 10 times $4\frac{1}{2}$ acres, which is 45 acres, in 10 days.

56. If A can make a shoe in $\frac{2}{3}$ of a day, in 2 days, or $\frac{6}{3}$ of a day, he can make as many shoes as $\frac{2}{3}$ is contained times in $\frac{6}{3}$, which is 3; if B can make a shoe in $\frac{2}{5}$ of a day, in 2 days, or $\frac{10}{5}$ of a day, he can make as many shoes as $\frac{2}{5}$ is contained times in $\frac{10}{5}$, which is 5: hence A can make 3 shoes and B 5 shoes in 2 days, and both can make 8 shoes.

57. If A can mow an acre in $\frac{3}{4}$ of a day, he can mow $\frac{4}{3}$ of an acre ($\frac{4}{3} \div \frac{3}{4}$) in a day; and if B can mow an acre in $\frac{3}{5}$ of a day, he can mow $\frac{5}{3}$ of an acre in a day; and hence both A and B can mow $\frac{4}{3}$ of an acre plus $\frac{5}{3}$ of an acre, or 3 acres in a day; if they can mow 3 acres in 1 day, they can mow 1 acre in $\frac{1}{3}$ of a day.

58. If A sent 5 men 4 days, he furnished 20 days' work; and if B sent 5 men 6 days, he furnished 30 days' work, and both A and B furnished 20 plus 30, or 50 days' work; since 20 is $\frac{2}{5}$ of 50, and 30 is $\frac{3}{5}$ of 50, A should receive $\frac{2}{5}$ of \$300, which is \$120, and B should receive $\frac{3}{5}$ of \$300, which is \$180.

59. Since they can both do $\frac{1}{5}$ plus $\frac{1}{8}$ of the work, or $\frac{13}{40}$ of the work, in a day, it will take both as many days to do the work as $\frac{13}{40}$ is contained times in $\frac{40}{40}$, which is $3\frac{1}{13}$: they can both do the work in $3\frac{1}{13}$ days.

60. Since A and B can build the wall in 8 days, they can build $\frac{1}{8}$ of it in 1 day; and since A alone can build it in 12 days, he can build $\frac{1}{12}$ of it in 1 day; and hence in 1 day B can build the difference between $\frac{1}{8}$ and $\frac{1}{12}$ of it, which is $\frac{1}{24}$ of it; if B can build $\frac{1}{24}$ of the wall in a day, it will take him 24 days to build the wall.

61. If A can do the work in 6 days, he can do $\frac{1}{6}$ of it in a day; and if B can do it in 8 days, he can do $\frac{1}{8}$ of it in a day, and A and B together can do $\frac{1}{6}$ plus $\frac{1}{8}$, or $\frac{7}{24}$, of it in a day; if they can do $\frac{7}{24}$ of the work in a day, it will take them as many days to do the work as $\frac{7}{24}$ is contained times in $\frac{24}{24}$, which is $3\frac{3}{7}$: A and B can do the work in $3\frac{3}{7}$ days.

62. If John can saw the wood in 6 days, he can saw $\frac{1}{6}$ of it in a day; and if John and Charles together can saw it in 4 days, they can saw $\frac{1}{4}$ of it in a day, and hence Charles can saw $\frac{1}{4}$ of it less $\frac{1}{6}$ of it, which is $\frac{1}{12}$ of it, in a day; hence it will take him 12 days to saw it alone.

63. If A and B can do $\frac{1}{3}$ of the work and A can do $\frac{1}{5}$ of it in a day, B can do $\frac{1}{3}$ of it less $\frac{1}{5}$ of it, which is $\frac{2}{15}$ of it, in a day; and it will take B as many days to do the work as $\frac{2}{15}$ is contained times in $\frac{15}{15}$, which is $7\frac{1}{2}$: B can do the work in $7\frac{1}{2}$ days.

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64. If A can do the work in 4 days, B in 5 days, and C in 6 days, A can do $\frac{1}{4}$ of it, B $\frac{1}{5}$ of it, and C $\frac{1}{6}$ of it in a day, and A, B, and C together can do $\frac{1}{4}$ plus $\frac{1}{5}$ plus $\frac{1}{6}$, or $\frac{37}{60}$, of it in a day; and it will take them as many days to do the work as $\frac{37}{60}$ is contained times in $\frac{60}{60}$, which is $1\frac{23}{37}$: A, B, and C can do the work in $1\frac{23}{37}$ days.

65. Since A and B can do the work in 10 days, or $\frac{1}{10}$ of it in a day, and A, B, and C can do it in 8 days, or $\frac{1}{8}$ of it in a day, C, in 1 day, can do the difference between $\frac{1}{8}$ and $\frac{1}{10}$, which is $\frac{1}{40}$, of it, and hence it will take C 40 days to do the work.

66. Since A, B, and C can do the job in 20 days, or $\frac{1}{20}$ of it in 1 day, and A and B can do it in 40 days, or $\frac{1}{40}$ of it in 1 day, C alone can do, in 1 day, the difference

between $\frac{1}{30}$ and $\frac{1}{40}$, which is $\frac{1}{40}$ of it, and hence C can do the job in 40 days; since A and C can do the work in 30 days, or $\frac{1}{30}$ of it in 1 day, and C $\frac{1}{40}$ of it, A can do the difference between $\frac{1}{30}$ and $\frac{1}{40}$, which is $\frac{1}{120}$ of it, in 1 day, and hence it will take A 120 days to do the job; since A and B can do $\frac{1}{40}$ of it, and A can do $\frac{1}{120}$ of it in a day, B alone can do, in 1 day, the difference between $\frac{1}{40}$ and $\frac{1}{120}$, which is $\frac{1}{60}$ of it, and hence it will take B 60 days to do the job: A can do the job in 120 days, B in 60 days, and C in 40 days.

67. If one man travels 20 miles and the other 25 miles a day, they approach each other at the rate of 20 miles plus 25 miles, or 45 miles a day; and it will take them as many days to meet as 45 miles are contained times in 495 miles, which is 11, and hence they will meet in 11 days.

68. If A saves as much as $\frac{7}{45}$ of B's income annually, in 5 years he will save as much as $\frac{35}{45}$, or $\frac{7}{9}$, of B's income, and since A owes $\frac{2}{3}$ of B's income, he will have left in five years the difference between $\frac{7}{9}$ and $\frac{2}{3}$ of B's income, or $\frac{1}{9}$ of B's income, which is \$50; if $\frac{1}{9}$ of B's income is \$50, his income is 9 times \$50, which is \$450.

69. If a man can perform half a journey in 5 days traveling 14 hours a day, he can perform half the journey in 5 times 14 hours, or in 70 hours, and it will take as many days to perform the other half of the journey, traveling 10 hours a day, as 10 hours are contained times in 70 hours, which is 7: hence it will take 7 days, traveling 10 hours each, to make the other half of the journey.

70. If it take $9\frac{1}{3}$ days, 8 hours a day, to do the work, if will take $9\frac{1}{3}$ times 8 hours, which is $78\frac{2}{3}$ hours, and it will take as many days, working 6 hours a day, as 6 hours are contained times in $78\frac{2}{3}$ hours, which is $13\frac{1}{15}$; and hence it will take $13\frac{1}{15}$ days to do the work.

71. If the hound run 7 rods while the hare runs 5, the hound runs 7 rods to gain 2 rods on the hare, or $3\frac{1}{2}$ rods to gain 1 rod, and to gain 30 rods the hound must run 30 times $3\frac{1}{2}$ rods, which is 105 rods.

72. Since 2 leaps of the hound equal 4 leaps of the hare, 1 leap of the hound equals 2 leaps of the hare, and hence the 50 leaps of the hare, the distance to be gained by the hound, equal 25 leaps of the hound, and the 4 leaps, which the hare makes while the hound makes 3, are equal to 2 leaps of the hound; hence, the hound makes 3 leaps to gain a distance equal to 1 leap of the hound, and, to gain a distance equal to 25 leaps of the hound, the hound must make 3 times 25 leaps, which is 75 leaps. The hound must take 75 leaps to catch the hare.

73. If a steamer sails 9 miles an hour down stream, it will sail 1 mile in $\frac{1}{9}$ of an hour, and, if it sails 5 miles an hour up stream, it will sail 1 mile in $\frac{1}{5}$ of an hour, and hence to sail 1 mile down stream and return, it will take $\frac{1}{9}$ plus $\frac{1}{5}$, or $\frac{14}{45}$, of an hour; if it can sail 1 mile down stream and back in $\frac{14}{45}$ of an hour, it can sail as many miles down stream and return in 14 hours, as $\frac{14}{45}$ of an hour is contained times in 14 hours, which is 45: hence it can sail 45 miles down stream and back in 14 hours.

74. If a steamer can sail 1 mile down stream in 5 minutes, and 1 mile up stream in 7 minutes, it can sail 1 mile down stream and back in 12 minutes, and hence it can sail as many miles down stream and back in 1 hour, as 12 minutes are contained times in 60 minutes, which is 5: hence it can sail 5 miles down stream and back in 1 hour.

SUGGESTION.—It may be well to direct pupils to solve the 74th problem before the 73d. The proof of the solutions of these problems will assist pupils in comprehending them clearly.

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75. If $\frac{2}{5}$ of what A did equaled $\frac{1}{5}$ of what B did, $\frac{1}{5}$ of A's work equaled $\frac{2}{5}$ of B's, and A's work equaled $\frac{10}{5}$ of B's, or twice B's, and hence A should receive twice as much as B, or twice \$18, which is \$36.

76. If a man spent $\frac{3}{4}$ of his money, he had $\frac{1}{4}$ of it left; if he then earned $\frac{1}{2}$ as much as he had spent, he earned $\frac{1}{2}$ of $\frac{3}{4}$, or $\frac{3}{8}$, of his money at first, and then had $\frac{1}{4}$ plus $\frac{3}{8}$ of it, or $\frac{5}{8}$ of it, which is $\frac{3}{8}$ less than he had at first, and hence $\frac{3}{8}$ of his money at first was \$21; if $\frac{3}{8}$ of it was \$21, his money at first was \$56.

77. If the father gave $\frac{7}{10}$ as much to the younger as to the elder son, he gave to both $\frac{10}{10}$ plus $\frac{7}{10}$, or $\frac{17}{10}$, of the elder's share, and hence $\frac{17}{10}$ of the elder's share equaled \$17000; if $\frac{17}{10}$ of the elder's share was \$17000, $\frac{1}{10}$ of it was \$1000, and his share was \$10000; the younger's share was $\frac{7}{10}$ of \$10000, which is \$7000.

78. If $\frac{8}{5}$ of the cost of the larger farm equaled $\frac{9}{10}$ of the cost of the smaller, $\frac{1}{5}$ of the cost of the larger was $\frac{8}{10}$ of the cost of the smaller, and the cost of the larger was $\frac{16}{10}$, or $\frac{8}{5}$, of the cost of the smaller; and hence $\frac{3}{2}$ plus $\frac{8}{5}$ of the cost of the smaller equaled \$8100; if $\frac{5}{2}$ of the cost of the smaller farm was \$8100, $\frac{1}{2}$ of its cost was \$1620, and its cost was \$3240; and the cost of the larger farm was $\frac{3}{2}$ of \$3240, which is \$4860.

79. If a pipe can fill a cistern in 4 hours, it can fill $\frac{1}{4}$ of it in 1 hour; if the second pipe can empty the cistern in 6 hours, it can empty $\frac{1}{6}$ of it in an hour; and hence if both pipes run, the part of the cistern filled each hour will be the difference between $\frac{1}{4}$ and $\frac{1}{6}$ of it, which is $\frac{1}{12}$; if $\frac{1}{12}$ of the cistern is filled each hour, it will take 12 hours to fill the cistern.

80. If $\frac{3}{5}$ of the elder's share equaled $\frac{3}{4}$ of the younger's share, $\frac{1}{5}$ of the elder's equaled $\frac{3}{8}$ of the younger's, and the elder's share equaled $\frac{3}{8}$ of the younger's, and hence the difference between the elder's and the younger's is $\frac{1}{8}$

of the younger's ($\frac{8}{8} - \frac{5}{8}$); if $\frac{1}{8}$ of the younger's share was \$200, his share was \$1600, and the elder's share was $\frac{8}{8}$ of \$1600, which is \$1800.

81. If A's capital is $\frac{3}{4}$ of B's, the capital of both is $\frac{7}{4}$ of B's, and since $\frac{3}{4}$ is $\frac{3}{7}$ of $\frac{7}{4}$, and $\frac{4}{4}$ is $\frac{4}{7}$ of $\frac{7}{4}$, A owns $\frac{3}{7}$ and B $\frac{4}{7}$ of the capital, and hence A is entitled to $\frac{3}{7}$ and B to $\frac{4}{7}$ of the profits; $\frac{3}{7}$ of \$2100, or \$900, is A's share, and $\frac{4}{7}$ of \$2100, or \$1200, is B's share.

82. If $\frac{3}{5}$ of A's capital equals $\frac{3}{8}$ of B's, $\frac{1}{5}$ of A's equals $\frac{1}{8}$ of B's, and A's capital equals $\frac{5}{8}$ of B's; and the entire capital is $\frac{8}{8}$ plus $\frac{5}{8}$, or $\frac{13}{8}$, of B's, and since $\frac{5}{8}$ is $\frac{5}{13}$ of $\frac{13}{8}$, A owns $\frac{5}{13}$ of the capital, and since $\frac{8}{8}$ is $\frac{8}{13}$ of $\frac{13}{8}$, B owns $\frac{8}{13}$ of it; and hence A should bear $\frac{5}{13}$ and B $\frac{8}{13}$ of the loss; $\frac{5}{13}$ of \$2600 is \$1000, A's share, and $\frac{8}{13}$ of \$2600 is \$1600, B's share.

83. If B's capital is $\frac{3}{4}$ of A's, and C's is $\frac{2}{3}$ of B's, C's is $\frac{2}{3}$ of $\frac{3}{4}$, or $\frac{2}{4}$, of A's, and the entire capital is $\frac{4}{4}$ plus $\frac{3}{4}$ plus $\frac{2}{4}$ of A's, which is $\frac{9}{4}$ of A's, and A owns $\frac{4}{9}$, B $\frac{3}{9}$, and C $\frac{2}{9}$ of the capital; and hence A is entitled to $\frac{4}{9}$, B to $\frac{3}{9}$, and C to $\frac{2}{9}$ of the profits; $\frac{4}{9}$ of \$6300 is \$2800, A's share, $\frac{3}{9}$ of \$6300 is \$2100, B's share, and $\frac{2}{9}$ of \$6300 is \$1400, C's share.

84. Since B lost $\frac{1}{6}$ of the cost, he sold the horse for $\frac{5}{6}$ of its cost; if \$80 is $\frac{5}{6}$ of the cost \$16 is $\frac{1}{6}$ of it and \$96 is the cost to B; if A sold it for $\frac{1}{5}$ more than it cost him, \$96 is $\frac{6}{5}$ of the cost of the horse to A, and hence A paid \$80 for the horse: A paid \$80 for the horse and sold it to B for \$96, and B sold it for \$80.

85. If the miller takes 10% of the grain for toll, the farmer receives back 90% of the grain, and hence the 120 pounds received by the farmer is $\frac{90}{100}$, or $\frac{9}{10}$, of the grain taken to the mill; if 120 pounds are $\frac{9}{10}$ of it, $\frac{1}{10}$ is $13\frac{1}{3}$ pounds, and the whole amount is 10 times $13\frac{1}{3}$ pounds, which is $133\frac{1}{3}$ pounds: hence the farmer must take $133\frac{1}{3}$ pounds of grain to mill to bring away 120 pounds.

RATIO AND PROPORTION.

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28. $\frac{1}{2} : \frac{2}{3} = \frac{1}{2} \div \frac{2}{3} = \frac{3}{4}$; $\frac{1}{3} : \frac{1}{2} = \frac{1}{3} \div \frac{1}{2} = \frac{2}{3}$;
$\frac{3}{4} > \frac{2}{3}$; hence $\frac{1}{2} : \frac{2}{3} > \frac{1}{3} : \frac{1}{2}$.

NOTE.—The sign of *inequality* ($>$) shows that the number or quantity placed at the opening is greater than the number or quantity placed at the apex or point. Thus, $\frac{3}{4} > \frac{2}{3}$ is read $\frac{3}{4}$ *is greater than* $\frac{2}{3}$, and $\frac{2}{3} < \frac{3}{4}$ is read $\frac{2}{3}$ *is less than* $\frac{3}{4}$. The use of this sign in the solutions of problems 28 and 32 is convenient.

32. $\frac{2}{3}$ lb. : $\frac{3}{4}$ lb. $= \frac{2}{3} \div \frac{3}{4} = \frac{8}{9}$;
$\frac{3}{5}$ yr. : $\frac{2}{3}$ yr. $= \frac{3}{5} \div \frac{2}{3} = \frac{9}{10}$;
$\frac{8}{9} = \frac{80}{90}$; $\frac{9}{10} = \frac{81}{90}$. $\therefore \frac{9}{10} > \frac{8}{9}$;
hence $\frac{3}{5}$ yr. : $\frac{2}{3}$ yr. $> \frac{2}{3}$ lb. : $\frac{3}{4}$ lb.

34. (1) $9 : 10 = \frac{9}{10}$; $24 : 23 = \frac{24}{23}$; $\frac{9}{10} \times \frac{24}{23} = \frac{108}{115}$.
(2) $7 : 15 = \frac{7}{15}$; $25 : 14 = \frac{25}{14}$; $\frac{7}{15} \times \frac{25}{14} = \frac{5}{6}$.

35. $12 : 25 = \frac{12}{25}$; $15 : 24 = \frac{15}{24}$; $16 : 21 = \frac{16}{21}$;
$\frac{12}{25} \times \frac{15}{24} \times \frac{16}{21} = \frac{8}{35}$, product.

36. $\frac{2}{3} : \frac{1}{2} = \frac{4}{3}$; $\frac{1}{4} : \frac{1}{3} = \frac{3}{4}$; $\frac{2}{5} : \frac{3}{4} = \frac{8}{15}$;
$\frac{4}{3} \times \frac{3}{4} \times \frac{8}{15} = \frac{8}{15}$, product.

38. $6 : 8 = \frac{6}{8}$; $10 : 12 = \frac{10}{12}$; $16 : 15 = \frac{16}{15}$;
$\frac{6}{8} \times \frac{10}{12} \times \frac{16}{15} = \frac{6 \times 10 \times 16}{8 \times 12 \times 15} = \frac{2}{3} = 2 : 3$.

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11. 21 : 7 : : 36 : 4th t.;
$21 \times$ 4th t. $= 7 \times 36$; 4th t. $= \frac{7 \times 36}{21} = 12$.
Or, 21 : 7 : : 36 : x;
$21 \times x = 7 \times 26$; $x = \frac{7 \times 26}{21} = 12$, the 4th term.

NOTES.—1. If $21 : 7 :: 36 : 12$, $\frac{21}{7} = \frac{36}{12}$; if $\frac{21}{7} = \frac{36}{12}$, $\frac{21 \times 12}{7 \times 12} = \frac{36 \times 7}{7 \times 12}$, and hence $21 \times 12 = 36 \times 7$. In like manner it may be shown

that in any proportion *the product of the extremes equals the product of the means.*

2. For convenience, the missing term in each of the proportions in problems 11 to 36 inclusive may be represented by x, as in the second solution above.

13. $x : 24 :: 8 : 32$;
$x \times 32 = 24 \times 8$; $x = \frac{24 \times 8}{32} = 6$, the 1st term.

15. $45 : 30 :: x : 24$;
$30 \times x = 45 \times 24$; $x = \frac{45 \times 24}{30} = 36$, the 3d term.

17. $7.2 : x :: 4.7 : 9.4 : x \times 4.7 = 7.2 \times 9.4$;
$x = \frac{7.2 \times 9.4}{4.7} = 14.4$, the 2d term.

19. $\frac{2}{3} : \frac{3}{4} :: \frac{5}{6} : x$; $\frac{2}{3} \times x = \frac{3}{4} \times \frac{5}{6}$;
$x = \frac{3}{4} \times \frac{5}{6} \div \frac{2}{3} = \frac{3}{4} \times \frac{5}{6} \times \frac{3}{2} = \frac{15}{16}$, the 4th term.

20. $\frac{3}{5} : \frac{2}{3} :: x : \frac{7}{8}$; $\frac{2}{3} \times x = \frac{3}{5} \times \frac{7}{8}$;
$x = \frac{3}{5} \times \frac{7}{8} \div \frac{2}{3} = \frac{3}{5} \times \frac{7}{8} \times \frac{3}{2} = \frac{63}{80}$, the 3d term.

21. $x : 2\frac{1}{3} :: \frac{1}{4} : \frac{3}{7}$; $x \times \frac{3}{7} = 2\frac{1}{3} \times \frac{1}{4}$;
$x = \frac{7}{3} \times \frac{1}{4} \div \frac{3}{7} = \frac{7}{3} \times \frac{1}{4} \times \frac{7}{3} = \frac{49}{36} = 1\frac{13}{36}$, the 1st term.

22. $\frac{1}{5} : x :: \frac{1}{5} : \frac{1}{6}$; $x \times \frac{1}{5} = \frac{1}{6} \times \frac{1}{3}$;
$x = \frac{1}{6} \times \frac{1}{3} \div \frac{1}{5} = \frac{1}{6} \times \frac{1}{3} \times \frac{5}{1} = \frac{5}{18}$, the 2d term.

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28. 45 sheep : 140 sheep :: \$265 : *Ans.;*
$\$265 \times 140 \div 45 = \$824.44\frac{4}{9}$, cost.

NOTE.—Only the statements, or proportions, are given in the solutions of problems 29 to 49 inclusive.

29. 70 A. : 640 A. :: \$1875 : *Ans.* = \$17142.857$\frac{1}{7}$.

30. \$3000 : \$4500 :: 120 A. : *Ans.* = 180 A.

31. (2) 4 lb. 6 oz. = 4.375 lb.; $17\frac{1}{4}$ lb. = 17.25 lb.
4.375 lb. : 17.25 lb. :: \$1.75 : *Ans.* = \$6.90.

32. 8 h. = 480 min.;
1 min. : 480 min. :: 75 : *Ans.* = 36000, times.

33. $9\frac{1}{4}$ h. = 555 min.;
1 min. : 555 min. :: 120 ticks : *Ans.* = 66600, ticks.

34. $40° 20' = 4\frac{1}{3}°$; $7\frac{1}{2}$ da. = 180, hours;
15 h. : 180 h. :: $4\frac{1}{3}°$: *Ans.* = 52°.

35. 160 men : 360 men. : 24 bbl. : *Ans.* = 54 bbl.

36. 3 ft. : 120 ft. :: 5 ft. shad. : *Ans.* = 200 ft. shadow.

37. 12 ft. shad. : 90 ft. shad. :: 20 ft. : *Ans.* = 150 ft.

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38. (1) $\frac{5}{8}$ farm : $\frac{3}{4}$ farm :: \$4500 : *Ans.* = \$6075.
(2) $\frac{5}{8}$ farm : $\frac{2}{3}$ farm :: \$4500 : *Ans.* = \$5400.

39. $\frac{7}{8}$ yd. : $33\frac{1}{3}$ yd. :: \$2.10 : *Ans.* = \$80.

40. \$58.75 : \$173.90 :: $6\frac{1}{4}$ T. : *Ans.* = $18\frac{1}{2}$ T.

41. 6 w. : 52 w. :: 24 bbl. : *Ans.* = 208 bbl.

42. 12 men : 25 men :: 20 A. : *Ans.* = $41\frac{2}{3}$ A.

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44. 5 men : 12 men :: 6 da. : *Ans.* = $14\frac{2}{5}$ da.

45. 5 da. : 12 da. :: 15 men : *Ans.* = 36 men.

47. (1) (8 + 12) : 8 :: 640 : smaller part = 256;
(8 + 12) : 12 :: 640 : larger part = 384.
(4) (7 + 25) : 7 :: 640 : smaller part = 140;
(7 + 25) : 25 :: 640 : larger part = 500.

48. (15 yr. + 17 yr.) : 15 yr. :: \$9600 : y'ger's = \$4500;
(15 yr. + 17 yr.) : 17 yr. :: \$9600 : elder's = \$5100.

49. (2 + 3) : 2 :: 150 miles : distance by 1st = 60 mi.;
(2 + 3) : 3 :: 150 miles : distance by 2d = 90 mi.

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2. $\left.\begin{matrix} 20 : 48 \\ 36 : 15 \\ 10 : 4 \end{matrix}\right\}$:: 25 : x; $x = \dfrac{48 \times 15 \times 4 \times 25}{20 \times 36 \times 10} = 10.$

3. $\left.\begin{matrix} 16 : 35 \\ 21 : 8 \\ 9 : 6 \\ 12 : 45 \end{matrix}\right\}$:: 16 : x; $x = \dfrac{35 \times 8 \times 6 \times 45 \times 16}{16 \times 21 \times 9 \times 12} = 33\frac{1}{3}.$

NOTE.—The 4th term in each solution may be found by *cancellation.*

4. $\left.\begin{matrix} 5 : 9 \\ 2.5 : 7.5 \\ 4 : 10 \end{matrix}\right\} :: 6 : x;\ x = \dfrac{9 \times 7.5 \times 10 \times 6}{5 \times 2.5 \times 4} = 81.$

5. $\left.\begin{matrix} 2\frac{1}{2} : 7 \\ 25 : 10 \\ 4 : 6\frac{1}{4} \\ 15 : 12 \end{matrix}\right\} :: 35 : x;\ x = \dfrac{7 \times 10 \times 6\frac{1}{4} \times 12 \times 35}{2\frac{1}{2} \times 25 \times 4 \times 15} = 49.$

7. $\left.\begin{matrix} 50 \text{ rd.} : 80 \text{ rd.} \\ 16 \text{ da.} : 15 \text{ da.} \end{matrix}\right\} :: 12 \text{ men} : \textit{Ans.};$

$$\frac{80 \times 15 \times 12 \text{ men}}{50 \times 16} = 18 \text{ men.}$$

NOTE.—Only the statements are given in solutions of problems 8 to 18 inclusive.

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8. $\left.\begin{matrix} 10 \text{ ft.} : 8 \text{ ft.} \\ 90 \text{ ft.} : 225 \text{ ft.} \end{matrix}\right\} :: \$30 : \textit{Ans.} = \$60.$

9. $\left.\begin{matrix} 6 \text{ men} : 8 \text{ men} \\ 8 \text{ days} : 9 \text{ days} \\ 9 \text{ hours} : 10 \text{ hours} \end{matrix}\right\} :: 576 \text{ cu. ft.} : \textit{Ans.} = 960 \text{ cu. ft.}$

10. $\left.\begin{matrix} 7 \text{ horses} : 15 \text{ horses} \\ 25 \text{ days} : 21 \text{ days} \end{matrix}\right\} :: 35 \text{ bu.} : \textit{Ans.} = 63 \text{ bu.}$

11. $\left.\begin{matrix} 6 \text{ da.} : 16 \text{ da.} \\ 10 \text{ hr.} : 8 \text{ hr.} \end{matrix}\right\} :: 120 \text{ miles} : \textit{Ans.} = 256 \text{ miles.}$

12. $\left.\begin{matrix} 24 \text{ in.} : 8 \text{ in.} \\ 16 \text{ in.} : 4 \text{ in.} \end{matrix}\right\} :: 1500 \text{ pieces} : \textit{Ans.} = 125, \text{ slabs.}$

NOTE.—The 1500 bricks are surface pieces and the 125 slabs are surface pieces, and hence both terms of the second couplet are like numbers.

13. $\left.\begin{matrix} 36 \text{ ft.} : 33 \text{ ft.} \\ 21 \text{ ft.} : 27 \text{ ft.} \end{matrix}\right\} :: \$84 : \textit{Ans.} = \$99.$

14. 5 men : 4 men
8 hours : 10 hours
:: 15 da. : *Ans.* = 15 da.

15. 40 ft. : 180 ft.
14 ft. : 21 ft.
$1\frac{1}{2}$ ft. : $1\frac{1}{4}$ ft.
:: \$120 : *Ans.* = \$675.

16. 72 rd. : 120 rd.
5 ft. : 6 ft.
2 ft. : $1\frac{1}{2}$ ft.
9 da. : 12 da.
:: 4 men : *Ans.* = 8 men.

17. 6 men : 16 men
50 ft. : 45 ft.
36 ft. : 25 ft.
8 ft. : 6 ft.
10 hr. : 8 hr.
:: 10 days : *Ans.* = 10 days.

18. 40 rd. : 15 rd.
6 ft. : $4\frac{1}{2}$ ft.
3 ft. : 2 ft.
12 da. : 9 da.
6 hr. : 8 hr.
:: 32 men : *Ans.* = 6 men.

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2. \$5000 + \$4000 = \$9000, capital;
\$9000 : \$5000 :: \$4500 : A's share profits = \$2500;
\$9000 : \$4000 :: \$4500 : B's share profits = \$2000.
Or, \$5000 ÷ \$9000 = $\frac{5}{9}$, A's part of capital;
\$4000 ÷ \$9000 = $\frac{4}{9}$, B's part of capital.
\$4500 × $\frac{5}{9}$ = \$2500, A's share of profits;
\$4500 × $\frac{4}{9}$ = \$2000, B's share of profits.
Or, \$4500 ÷ \$9000 = $\frac{1}{2}$, part profits are of capital;
\$5000 × $\frac{1}{2}$ = \$2500, A's share of profits;
\$4000 × $\frac{1}{2}$ = \$2000, B's share of profits.

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3. $\$8000 + \$4500 + \$3500 = \$16000$, capital;
$\$8000 \div \$16000 = \frac{1}{2}$, A's part of capital;
$\$4500 \div \$16000 = \frac{9}{32}$, B's part of capital;
$\$3500 \div \$16000 = \frac{7}{32}$, C's part of capital.
$\$3200 \times \frac{1}{2} = \$1600$, A's share of loss;
$\$3200 \times \frac{9}{32} = \$900$, B's share of loss;
$\$3200 \times \frac{7}{32} = \$700$, C's share of loss.

NOTE.—This problem and also problems 5 and 8 may be solved by proportion, and also by finding what part the profits are of the capital, and then taking this part of each partner's capital for his share of the profits, as in solution to problem 2 above.

4. $(4+3) : 4 :: \$7700 :$ 1st partner's share $= \$4400$;
$(4+3) : 3 :: \$7700 :$ 2d partner's share $= \$3300$.
Or, $4 + 3 = 7$; $4 \div 7 = \frac{4}{7}$; $3 \div 7 = \frac{3}{7}$;
$\$7700 \times \frac{4}{7} = \$4400$, 1st partner's share;
$\$7700 \times \frac{3}{7} = \$3300$, 2d partner's share.

5. $\$4000 + \$6400 + \$5600 = \$16000$, capital;
$\$4000 \div \$16000 = \frac{1}{4}$, A's part of capital;
$\$6400 \div \$16000 = \frac{2}{5}$, B's part of capital;
$\$5600 \div \$16000 = \frac{7}{20}$, C's part of capital.
$\$3200 \times \frac{1}{4} = \$800$, A's share of gain;
$\$3200 \times \frac{2}{5} = \$1280$, B's share of gain;
$\$3200 \times \frac{7}{20} = \$1120$, C's share of gain.

(2) $\$20000 \times \frac{1}{4} = \$5000$, A's share of proceeds;
$\$20000 \times \frac{2}{5} = \$8000$, B's share of proceeds;
$\$20000 \times \frac{7}{20} = \$7000$, C's share of proceeds.

6. $\$5460 \times \frac{2}{3} = \$3640$, A's share of profits 1st year;
$\$5460 \times \frac{1}{4} = \$1365$, A's share of profits 2d year;
$\$3640 + \$1365 = \$5005$, A's total share of profits;
$\$5460 \times \frac{1}{3} = \$1820$, B's share of profits 1st year;
$\$5460 \times \frac{3}{4} = \$4095$, B's share of profits 2d year;
$\$1820 + \$4095 = \$5915$, B's total share of profits.

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8. $\$5000 \times 2 + \$4000 \times 2 = \$18000$, A's cap'l for 1 yr.;
$\$5000 \times 2 + \$3000 \times 2 = \$16000$, B's cap'l for 1 yr.;
$\$5000 \times 2 + \$2000 \times 2 = \$14000$, C's cap'l for 1 yr.;
$\$18000 + \$16000 + \$14000 = \$48000$, total cap'l 1 yr.;
$\$18000 \div \$48000 = \frac{3}{8}$, A's part of capital;
$\$16000 \div \$48000 = \frac{1}{3}$, B's part of capital;
$\$14000 \div \$48000 = \frac{7}{24}$, C's part of capital;
$\$3600 \times \frac{3}{8} = \$1350$, A's share of loss;
$\$3600 \times \frac{1}{3} = \$1200$, B's share of loss;
$\$3600 \times \frac{7}{24} = \$1050$, B's share of loss.

INVOLUTION AND EVOLUTION.

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60. $75.364 = 75.3640$; $\sqrt{75.3640} = 8.68+$.

63. $586.7 = 586.70$; $\sqrt{586.70} = 24.221+$.

66. $\sqrt{\frac{625}{2304}} = \frac{\sqrt{625}}{\sqrt{2304}} = \frac{25}{48}$.

68. $\sqrt{272\frac{1}{4}} = \sqrt{\frac{1089}{4}} = \frac{33}{2} = 16\frac{1}{2}$.

Or, $272\frac{1}{4} = 272.25$; $\sqrt{272.25} = 16.5 = 16\frac{1}{2}$.

69. $\sqrt{1040\frac{1}{16}} = \sqrt{\frac{16641}{16}} = \frac{129}{4} = 32\frac{1}{4}$.

70. $\sqrt{2} = \sqrt{2.000000} = 1.414+$.

NOTE.—The square root of 2 to fifteen decimal orders is 1.414213562373095+.

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45.

$$\begin{array}{rl} & 15.625(2.5 \\ 2^2 = & \underline{\ 8\ } \\ 2^2 \times 3 = & 12)7.6 \\ 2.5^3 = & \underline{15.625} \end{array}$$

47.

$$\begin{array}{rrl} & & .07\dot{4}25\dot{6}(.4203+ \\ & .4^3 = & \underline{.064} \\ .4^2 & \times 3 = & .48)102 \\ .42^3 & = & \underline{.074088} \\ .42^2 & \times 3 = & .5292)1680 \\ .420^2 & \times 3 = & .529200)1680000 \\ .4203^3 & = & \underline{.074246873427} \\ & & 9126573 \end{array}$$

52. $\sqrt[3]{\frac{216}{1728}} = \frac{\sqrt[3]{216}}{\sqrt[3]{1728}} = \frac{6}{12} = \frac{1}{2}$.

Or, $\frac{216}{1728} = \frac{1}{8}$; $\sqrt[3]{\frac{1}{8}} = \frac{1}{2}$.

53. $\sqrt[3]{\frac{1331}{42875}} = \frac{\sqrt[3]{1331}}{\sqrt[3]{42875}} = \frac{11}{35}$.

55. $\sqrt[3]{5\frac{104}{125}} = \sqrt[3]{\frac{729}{125}} = \frac{9}{5} = 1\frac{4}{5}$.

Or, $5\frac{104}{125} = 5.832$; $\sqrt[3]{5.832} = 1.8 = 1\frac{4}{5}$.

56. $\sqrt[3]{37\frac{1}{27}} = \sqrt[3]{\frac{1000}{27}} = \frac{10}{3} = 3\frac{1}{3}$.

57. $\sqrt[3]{2} = \sqrt[3]{2.000000000} = 1.259+$.

59. $\sqrt[3]{19683} = 27$, length of edge in inches.

60. 2150.4 cu. in. $\times$ 100 = 215040 cu. in., in 100 bu.;
$\sqrt[3]{215040} = 59.9+$, length of edge in inches.

61. $\sqrt[3]{41063.625} = 34.5$, length of edge in inches.

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2. $20^2 - 16^2 = 144$; $\sqrt{144} = 12$, in. in perpendicular

3. $45^2 - 27^2 = 1296$; $\sqrt{1296} = 36$, feet in base.

4. $192^2 + 144^2 = 57600$; $\sqrt{57600} = 240$, yards.

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5. $24^2 + 18^2 = 900$; $\sqrt{900} = 30$, no. of ft. in ladder.

6. $96^2 + 72^2 = 14400$; $\sqrt{14400} = 120$, no. of rds. apart.

7. $180^2 + 135^2 = 50625$;
$\sqrt{50625} = 225$, no. of ft. in distance.

8. $240^2 - 208^2 = 14336$;
$\sqrt{14336} = 119.73+$, no. of ft. high.

9. $100^2 \times .7854 = 7854$, number of sq. ft. in area;
7854 sq. ft. $\div$ 9 sq. ft. $= 872\frac{2}{3}$, no. of sq. yd. in pond.

10. $78.54 \div .7854 = 100$;
$\sqrt{100} = 10$, no. of yd. in diameter.

11. $3^2 : 24^2 :: 1 : Ans. = 64$, no. of small circles in larger circle.

Since the areas of circles are to each other as the squares of their diameters (Art. 372, prin. 3), the circle whose diameter is 3 inches is to the circle whose diameter is 24 inches as 3^2 is to 24^2. But 3^2, or 9, is to 24^2, or 576, as 1 is to 64, and hence 64 circles 3 inches in diameter equal 1 circle 24 inches in diameter.

12. $15^2 : 60^2 :: 1 : Ans. = 16$, no. of smaller circles equal in area to larger circle.

Or, since the diameters are to each other as 1 to 4, the areas are to each other as 1^2 is to 4^2, or as 1 is to 16, and hence 16 circles 15 inches in diameter are equal to 1 circle 60 inches, or 8 feet, in diameter.

13. 9 sq. ft. $\times 218\frac{1}{2} = 1963.5$ sq. ft., area of circle;
1963.5 $\div$.7854 $= 2500$, square of diameter;
$\sqrt{2500} = 50$, number of feet in diameter;
50 ft. $\div 2 = 25$ ft., the radius, or distance from stake.

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14. $3^2 = 9$;
9 sq. in. $\times .7854 = 7.0686$ sq. in., area of circle;
2.5 sq. ft. $\times 2.5 = 6.25$ sq. ft., area of square;
144 sq. in. $\times 6.25 = 900$ sq. in.;
900 sq. in. $\div$ 7.0686 sq. in. $= 127.32+$, no. of circles equal to 1 square.

NOTE.—The number of circles 3 inches in diameter which can be *inscribed* in a surface 2.5 ft. square (30 in. square), is 10×10, or 100.

15. (2) $15^2 = 225$; 225 sq. in. $\times$ 3.1416 = 706.86 sq. in.

16. $7912^2 \times 3.1416 = 196663355.7504$, no. of sq. mi.

17. $7912^3 \times .5236 = 259333411782.8608$, cu. mi. in earth.

Or, 7912 mi. $\div$ 6 = $1318\frac{2}{3}$ mi., $\frac{1}{6}$ of diameter;

$7912^2 \times 3.1416 = 196663355.7504$, sq. mi. in surface;

$196663355.7504 \times 1318\frac{2}{3} = 259333411782.8608$, cu. mi. in earth.

18. (2) $9^3 \times .5236 = 381.7044$, number cu. in. in ball.

Or, $9^2 \times 3.1416 \times \frac{2}{3} = 381.7044$, number cu. in. in ball.

19. $2^3 : 8^3 :: 1 :$ *Ans.* = 64, number of smaller balls equal to larger.

Since two cubes are to each other as the cubes of their diameters (Art. 273, Prin. 3), the ball whose diameter is 2 inches is to the ball whose diameter is 8 inches, as 2^3 is to 8^3, or as $1^3 : 4^3$, or as 1 to 64, and hence 64 balls 2 inches in diameter equal 1 ball 8 inches in diameter.

20. 28274400 $\div$ 3.1416 = 9000000, square of diameter;

$\sqrt{9000000} = 3000$, number of miles in diameter.

21. (1) $1^3 : 4^3 :: 1 :$ *Ans.* = 64, number of moon volumes in 1 earth volume.

(2) $1^2 : 4^2 :: 1 :$ *Ans.* = 16, number of times moon's surface in earth's surface.

NOTE.—These answers are not correct, *as facts*, since the diameters are not exactly as 1 to 4. The moon's surface is about $\frac{1}{16}$ of the earth's surface.

22. 850000 $\div$ 85000 = 10;

$1^3 : 10^3 :: 1 :$ *Ans.* = 1000, number of times sun is larger than Jupiter.

Since the sun's diameter is 10 times Jupiter's diameter, their diameters are to each other as 1 to 10, and their volumes are to each other as 1^3 to 10^3, or as 1 to 1000, and hence the volume of the sun is 1000 times the volume of Jupiter.

(2) $1^2 : 10^2 ::$ Jupiter's sur. : sun's sur.; $1 : 100 = \frac{1}{100}$.

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23. 18816613200000 ÷ .5236 = 35937000000000, cube of diameter;

$\sqrt[3]{35937000000000} = 33000$, miles in diameter.

24. 904.7808 ÷ .5236 = 1728, cube of diameter;

$\sqrt[3]{1728} = 12$, inches in diameter;

25. 7238246.4 ÷ .5236 = 13824000, cube of diameter;

$\sqrt[3]{13824000} = 240$, miles in diameter.

26. 10 in. × 3.1416 = 31.416 in., circumference of base;

31.416 sq. in. × 6 = 188.496 sq. in., convex surface.

27. 20 in. × 4 = 80 in., perimeter of base;

80 sq. in. × 15 = 1200 sq. in., convex surface;

20 sq. in. × 20 = 400 sq. in., area of base;

1200 sq. in. + 400 sq. in. = 1600 sq. in., in entire surface.

28. $12^2 = 144$, no. of sq. in. in base of pyramid;

144 cu. in. × 5 = 720 cu. in., solid con. of pyramid;

$12^2 \times .7854 = 113.0976$, no. sq. in. in base of cone;

113.0976 cu. in. × 5 = 565.488 cu. in. solid contents of cone;

720 cu. in. — 565.488 cu. in. = 154.512 cu. in., difference.

29. $10^2 \times .7854 = 78.54$, number sq. in. in larger base;

$6^2 \times .7854 = 28.2744$, no. sq. in. in smaller base;

78.54 sq. in. × 28.2744 = 2220.671376 sq. in., product;

$\sqrt{2220.671376} = 47.124$, square root of product;

78.54 + 28.2744 + 47.124 = 153.9384;

153.9384 × 4 = 615.7536, cu. in. in cone frustum.

30. $10^2 = 100$, number sq. in. in lower base;

$6^2 = 36$, number sq. in. in smaller base;

100 × 36 = 3600; $\sqrt{3600} = 60$, sq. root of product ➢

100 sq. in. + 36 sq. in. + 60 sq. in. = 196 sq. in;

196 × 5 = 980, number of cu. in. in frustum.

GENERAL REVIEW.

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1. $1250 - 592 = 658$, subtrahend.
2. $71 \times 42 + 15 = 2997$, dividend.
3. 3760 lb. $\div 2000$ lb. $= 1.88$, number of tons;
 $\$8.50 \times 1.88 = \$15.98$, cost,
4. $4\frac{1}{2}$ T. $= 90$ cwt.; $\$.50 \times 90 = \$45$, sale receipts;
 $\$45 - \$36 = \$9$, gain.
5. $\$3560.75 \div \$24.50 = 145\frac{83}{98}$, number of acres.
6. $\frac{1}{2}$ of $\frac{7}{8} = \frac{7}{16}$; $\frac{2}{6}$ of $2\frac{1}{2} = 1$;
 $\frac{2}{3} + \frac{5}{6} + \frac{7}{16} + 1 =$
 $\frac{32}{48} + \frac{40}{48} + \frac{21}{48} + 1 = 1\frac{93}{48} = 2\frac{45}{48} = 2\frac{15}{16}$.
7. $\frac{3}{5}$ of $6\frac{1}{4} = \frac{15}{4} = 3\frac{3}{4}$; $\frac{1}{5}$ of $3\frac{1}{3} = \frac{2}{3}$;
 $17\frac{1}{2} - 3\frac{3}{4} = 13\frac{3}{4}$; $13\frac{3}{4} \times \frac{2}{3} = \frac{55}{4} \times \frac{2}{3} = 9\frac{1}{6}$.
8. $\frac{3}{4}$ of $\frac{2}{3} \times \frac{7}{8}$ of $\frac{5}{7} = \frac{5}{16}$; $\frac{2}{3}$ of $\frac{9}{20} = \frac{3}{10}$;
 $\frac{5}{16} \div \frac{3}{10} = \frac{50}{48} = 1\frac{1}{24}$.
9. $\frac{3}{5}$ of $6\frac{1}{4} = \frac{15}{4}$; $\frac{2}{3}$ of $7\frac{1}{2} = 5$; $\frac{15}{4} \div 5 = \frac{3}{4}$.
10. $145 \div 28\frac{5}{7} = \frac{1015}{7} \div \frac{201}{7} = 5\frac{10}{201}$.
11. $215\frac{2}{3} + 125\frac{3}{4} = 341\frac{5}{12}$, sum;
 $215\frac{2}{3} - 125\frac{3}{4} = 89\frac{11}{12}$, difference;
 $341\frac{5}{12} - 89\frac{11}{12} = 251\frac{1}{2}$.
12. $\frac{5}{8} + \frac{2}{8}$ of $\frac{3}{4} = \frac{5}{8} + \frac{1}{2} = \frac{9}{8}$;
 $\frac{5}{8} - \frac{2}{8}$ of $\frac{3}{4} = \frac{5}{8} - \frac{1}{2} = \frac{1}{8}$;
 $\frac{9}{8} \times \frac{1}{8} = \frac{9}{64}$.
13. $2\frac{1}{2} \div 3\frac{1}{8} = \frac{5}{2} \times \frac{8}{10} = \frac{4}{5}$;
 $\frac{4}{5} \times 3\frac{1}{5} = \frac{4}{5} \times \frac{16}{5} = \frac{12}{5} = 2\frac{2}{5}$.
14. $3 \div 8\frac{13}{16} = \frac{3}{1} \div \frac{141}{16} = \frac{48}{141} = \frac{16}{47}$.

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15. 640 A. $\times \frac{9}{16} = 360$ A.;
 $360 \times \frac{2}{3} = 240$ A.;
 360 A. $\times \frac{1}{3} = 120$ A.;

$10 \times 240 = \$2400$; $\$12 \times 120 = \$1440$;
$\$2400 + \$1440 = \$3840$;
$\$3840 - \$2880 = \$960$, gain.

16. $\frac{8}{9}$ of $\frac{7}{8} = \frac{21}{40}$; $\$16800 \div \frac{21}{40} = \$32000$, cost;
$\frac{7}{8} - \frac{21}{40} = \frac{35}{40} - \frac{21}{40} = \frac{14}{40} = \frac{7}{20}$, part left.

17. $.009 + .03 + 7. = 7.039$.

18. $.0015 - .000027 = .001473$;
$.001473 \times 20.5 = .0301965$.

19. $160 \times .016 = 2.56$; $2.56 \div .0025 = 1024$.

20. $.015 \times .15 = .00225$; $.00225 - .000015 = .002235$.

21. $.256 \div .000016 = 16000$.

22. $625 \times .003 = 1.875$; $1.875 \div 2.5 = .75$.

23. $\frac{3}{400} = .0075$; $.0075 \div 2.5 = .003$.

24. $\frac{8}{125} = .064$; $.064 \div 5000 = .0000128$.

25. .625 lb. = 7.5 oz.; .5 oz. = 10 pwt.; 7 oz. 10 pwt.

26. .165 ft. $\div$ 16.5 ft. = .01, part of rod.

27. $\$2.25 \times .063 = \$.14175$.

28. (1) $28 \times 24 \times 60$ min. = 40320 min.
(2) $29 \times 24 \times 60$ min. = 41760 min.

29. 30 da. + 31 da. + 31 da. = 92 da., in sum. months;
$92 \times 24 \times 60 \times 60$ sec. = 7948800 sec.

30. $2\frac{1}{4} \times 320 \times 16\frac{1}{2}$ ft. = 11880 ft.;
11880 ft. $\div 2\frac{1}{8}$ ft. = $5091\frac{3}{7}$, number of steps.

31. $320 \times 16\frac{1}{2}$ ft = 5280 ft.;
5280 ft. $\div 12\frac{1}{2}$ ft. = $422\frac{2}{5}$, number of rotations.

32. $2\frac{1}{4} \times 320$ rd. = 720 rd.;
720 sq. rd. $\times 4 = 2880$ sq. rd.;
2880 sq. rd. $\div$ 160 sq. rd. = 18, number of acres.

33. 480 pp. $\div$ 16 pp. = 30, number of sheets in 1 book;
30 sheets $\times$ 1200 = 36000 sheets = 75 reams.

34. 27 oz. 10 pwt. = 550 pwt. = 13200 gr.;
13200 gr. $\times$ 14 = 184800 gr.

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35. .75 lb. = 9 oz. = 180 pwt.;
180 pwt. $\div$ 3.2 pwt. = 56 (rings), with .8 pwt. rem.

36. 12 sq. ft. $\times 7\frac{1}{2} \div 12 = 7\frac{1}{2}$ sq. ft., in each board;
$7\frac{1}{2}$ sq. ft. $\times 40 = 300$ sq. ft.

37. 20 sq. ft. $\times \frac{9}{12} \times 1\frac{1}{2} = 22\frac{1}{2}$ sq. ft. $= .022\frac{1}{2}$ M. sq. ft.;
$\$30 \times .022\frac{1}{2} = \$.675$, cost.

38. 36 sq. ft. $\times 9\frac{1}{2} = 342$ sq. ft. $= 38$ sq. yd.;
$\$.40 \times 38 = \$15.20$, cost.

39. 45 rd. $\times 4 = 180$ rd. $= 2970$ ft., in perimeter;
2970 ft. $\div 2\frac{1}{2}$ ft. $= 1188$, number of steps.

40. 28 rd. $\times 4 = 112$ rd. $= 1848$ ft., in perimeter;
1848 ft. $\div 14$ ft. $= 132$, number of lengths.

41. 60 rd. $\times 2 + 37\frac{1}{2}$ rd. $\times 2 = 195$ rd. $= 3217\frac{1}{2}$ ft., peri.;
$3217\frac{1}{2}$ ft. $\div 12$ ft. $= 268\frac{1}{8}$, no. of lengths;
5 boards $\times 268\frac{1}{8} = 1340\frac{5}{8}$ boards (in practice 1345).

42. 8 sq. in. $\times 4 = 32$ sq. in.;
144 sq. in. $\div 3$ sq. in. $= 4\frac{1}{2}$, bricks to 1 sq. ft.;
16 sq. ft. $\times 16\frac{1}{2} \times 6\frac{1}{2} = 1716$ sq. ft., surface of walk;
$4\frac{1}{2}$ bricks $\times 1716 = 7722$ bricks.

43. 4 sq. mi. $\times 2\frac{1}{4} = 9$ sq. mi. $= 9$, no. of sections.
(2) 640 A. $\times 9 = 5760$ A.

44. 640 A. $\times 3\frac{1}{4} = 2080$ A.;
$\$6.25 - \$4.50 = \$1.75$, gain per A.;
$\$1.75 \times 2080 = \$3640$, total gain.

45. $\$3280 \div 160 = \$20.50$, selling price per acre.

46. 40 cu. ft. $\times 21\frac{1}{2} \times 4 = 3440$ cu. ft. $= 127\frac{11}{27}$ cu. yd.;
$\$.75 \times 127\frac{11}{27} = \$95.55\frac{5}{9}$, cost.

47. (120 cu. ft. $\times 54 \times 9) \div 27$ cu. ft. $= 2160$, no. cu. yd.

48. 120 ft. $\times 2 = 240$ ft., length of 2 opposite walls;
(120 ft. $- 22$ ft.) $\times 2 = 196$ ft., length of other walls;
240 ft. $+ 196$ ft. $= 436$ ft., length of walls;
436 cu. ft. $\times 11 \times 33\frac{1}{3} = 159866\frac{2}{3}$ cu. ft.;
$159866\frac{2}{3}$ cu. ft. $\div 24\frac{3}{4}$ cu. ft. $= 6459\frac{7}{27}$, no. of perches.

NOTE.—The answer required by this problem is the number "of perches of *stone* in the walls," and not the number of perches of *masonry*. If the perches of masonry were required, the outside girth, or 480 ft., would be considered the length of the four walls. See New Comp. Arithmetic, p. 172, prob. 10, note.

49. (1) $80^{Dm} = 800^{m}$; $8^{dm} = .8^{m}$;
$800^{cu.\,m} \times 1.4 \times .8 = 896^{cu.\,m}$;
$\$.35 \times 896 = \$313.60$, cost.
(2) 1.308 cu. yd. $\times$ 896 = 1171.968 cu. yd. (in 896^{m});
$\$.33\frac{1}{3} \times 1171.968 = \$390.656$, cost.

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50. $32^{cu.\,m} \times 2.5 \times .65 = 52^{cu.\,m}$.

51. $40 \times 6\frac{1}{2} = 260$; $260 \div 32 = 8\frac{1}{8}$, number of cords;
$\$4.50 \times 8\frac{1}{8} = \$36.56\frac{1}{4}$, cost.

52. $36 \times 8 = 288$; $288 \div 32 = 9$, number of cords;
$\$5.50 \times 9 = \$49.50$, cost.

53. $85\frac{1}{2} \times 6 = 513$; $513 \div 32 = 16\frac{1}{32}$, number of cords;
$\$2.625 \times 16\frac{1}{32} = \$42.082\frac{1}{32}$, cost.

54. $\frac{1}{2}$, A's part; $\frac{2}{3}$ of $\frac{1}{2} = \frac{1}{3}$, B's part;
$\frac{1}{2} - \frac{1}{3} = \frac{1}{6}$, C's part;
1360 lb. $\times \frac{1}{2} = 680$ lb., A's share;
1360 lb. $\times \frac{1}{3} = 453\frac{1}{3}$ lb., B's share;
1360 lb. $\times \frac{1}{6} = 226\frac{2}{3}$ lb., C's share.

55. 2 bu. 3 pk. 2 qt. = 90 qt.;
366 bu. 3 pk. 4 qt. = 11740 qt.;
11740 qt. $\div$ 90 qt. = 130 (sacks), with 40 qt. rem.

56. 3 oz. 3 pwt. 8 gr. = 3 oz. $3\frac{1}{3}$ pwt. = $3\frac{1}{6}$ oz.;
$3\frac{1}{6}$ oz. $\times$ 6 = 19 oz., weight of 6 spoons;
$\$2.25 \times 19 = \$42.75$, cost of spoons;
$\$1.25 \times 14 = \$17.50$, cost of chain,
$\$42.75 + \$17.50 = \$60.25$, total cost.

57. 8 cu. in. $\times$ 4 $\times$ $2\frac{1}{2} = 80$ cu. in., con. of 1 brick;
80 cu. in. $\div$ 1728 cu. in. $= \frac{5}{108}$, part of cu. ft.;
2 rd. = 33 ft.;
33 cu. ft. $\times$ 6 $\times$ $1\frac{1}{2} = 297$ cu. ft., contents of wall;
297 cu. ft. $\div \frac{5}{108}$ cu. ft. $= 6415\frac{1}{5}$, number of bricks.
Or, 8 cu. in. $\times$ 4 $\times$ $2\frac{1}{2} = 80$ cu. in., in 1 brick;
33 cu. ft. $\times$ 6 $\times$ $1\frac{1}{2} = 297$ cu. ft., in wall;
(1728 cu. in. $\times$ 297) $\div$ 80 cu. in. $= 6415\frac{1}{5}$, no. of bricks.

58. 7° 49′ long. = 31 min. 16 sec. in time;
12 h. — 31 min. 16 sec. = 11 h. 28 min. 44 sec.
The time at Cincinnati is 11 h. 28 min. 44 sec. A. M.; or 28 min. 44 sec. past 11 o'clock A. M.

59. 75° long. = 5 h. in time;
12 h. + 5 h. = 17 h.
The clock-time at London is 17 hours past midnight, or 5 P. M.

60. 81° 47′ — 71° 4′ 9″ = 10° 42′ 51″, diff. in long.;
10° 42′ 51″ long. = 42 min. $51\frac{3}{5}$ sec. in time;
The hour at Boston is 4 h. 42 min. $51\frac{3}{5}$ sec. P. M.; or 42 min. $51\frac{3}{5}$ sec. past 4 P. M.

61. 2 ft. 9 in. = 33 in.; $16\frac{1}{2}$ ft. = 198 in.;
33 in. ÷ 198 in. = $\frac{1}{6}$.

62. 1 mi. = 320 rd.; 208 rd. ÷ 320 rd. = .65, dec. of mi.

63. $\frac{5}{8} \div 30\frac{1}{4} \div 160 = \frac{5}{38720} = \frac{1}{7744}$, part of acre.
Or, 1 A. = 160 sq. rd. = 4840 sq. yd.;
$\frac{5}{8} \div 4840 = \frac{1}{7744}$, of acre.

64. $\frac{4}{5}$ oz. = $\frac{4}{5}$ of $\frac{1}{12}$ lb. = $\frac{1}{15}$ lb.; $\frac{7}{8}$ lb. — $\frac{1}{15}$ lb. = $\frac{97}{120}$ lb.
Or, $\frac{7}{8}$ lb. = $10\frac{1}{2}$ oz.;
$10\frac{1}{2}$ oz. — $\frac{4}{5}$ oz. = $9\frac{7}{10}$ oz. = 9 oz. 14 pwt.

65. $\frac{3}{8}$ qt. ÷ 32 qt. = $\frac{3}{256}$, part of bu.
Or, $\frac{3}{8}$ qt. = $\frac{3}{8}$ of $\frac{1}{32}$ bu. = $\frac{3}{256}$ bu.

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66. 100% — 8% = 92%; 92% × .25 = .23%, died;
92% — 23% = 69%, mustered;
621 ÷ .69 = 900, no. of men in regiment at first.

67. \$167.50 — \$150 = \$17.50, gain;
\$17.50 ÷ \$150 = .11⅔ = 11⅔%, gain per cent.

68. \$1800 ÷ 500 = \$3.60, cost per yard;
\$3.60 × 1.25 = \$4.50, selling price.
Or, 25% = ¼; \$3.60 × ⅝ = \$4.50, selling price.

69. 100% — 25% = 75%; \$24 ÷ .75 = \$32, cost.
\$34 — \$32 = \$2, gain; \$2 ÷ \$32 = .06¼ = 6¼%.

70. 100% + 20% = 120%;
120% × .20 = 24%, loss % on cost;
120% − 24% = 96% (selling price 96% of cost);
100% − 96% = 4%, loss per cent.

71. \$240 ÷ 1.20 = \$200, cost of 1st carriage;
\$240 ÷ .80 = \$300, cost of 2d carriage;
\$200 + \$300 = \$500, cost of both carriages;
\$500 − \$480 = \$20, loss.

Or, \$240 − \$200 = \$40, gain on 1st carriage;
\$300 − \$240 = \$60, loss on 2d carriage;
\$60 − \$40 = \$20, loss.

72. \$72 × 1.25 = \$90, selling price;
\$90 ÷ .90 = \$100, price asked.

73. 130% × .10 = 13%, per cent of cost deducted;
30% − 13% = 17%, per cent of cost gained;
\$5800 × .17 = \$986, amount gained.

Or, 130% × .90 = 117%, per cent of cost selling price;
117% − 100% = 17%, per cent of cost gained;
\$5800 × .17 = \$986, amount gained.

Or, \$5800 × 1.17 = \$6786, sale receipts;
\$6786 − \$5800 = \$986, gain.

4. \$4 × 1.20 = \$4.80, selling price;
\$4.80 ÷ .80 = \$6.00, price asked.

To gain 20%, I must sell the cloth for 120% of \$4, which is \$4.80, and since the selling price is to be 20% less than the price asked, \$4.80 is 80% of the price asked.

75. 120% − 75% = 45%, gain per cent;
45% ÷ 75% = .60 = 60%, gain % on investment.

He bought at 75% and sold at 120% of the par value, gaining 120% − 75%, or 45%, of the par value, which is $\frac{45}{75}$, or 60%, of his investment.

76. 100% − $33\frac{1}{3}$% = $66\frac{2}{3}$%; $66\frac{2}{3}$% × 1.50 = 100%.

He lost $33\frac{1}{3}$% of the apples, and sold $66\frac{2}{3}$% at 150% of the cost, which was 100% of the cost of the whole *lot: hence* he neither gained nor lost.

77. $\$.04\frac{1}{2} \times 100 \times 63 = \$283.50$, cost;
$\$283.50 \times \frac{2}{3} = \$189.00$, cost of $\frac{2}{3}$;
$\$283.50 \times \frac{1}{2} = \$141.75$, cost of $\frac{1}{2}$;
$\$189.00 - \$141.75 = \$47.25$, loss on $\frac{2}{3}$ sold;
$\$47.25 \div \$189.00 = .25 = 25\%$, loss % on $\frac{2}{3}$ sold.
Or, $\frac{2}{3} - \frac{1}{2} = \frac{1}{6}$, part of cost lost;
$\frac{1}{6} \div \frac{2}{3} = \frac{1}{4} = .25 = 25\%$.

It is to be observed that here, as in all other cases, the *base* is the cost of the goods sold.

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78. $\$128.25 \times 1.04 = \$133.38$, am't for 6 mo., at 8%;
$\$133.38 \times 1.06 = \$141.3828$, selling price.

79. $\$800 \times 1.03 = \$824$, amount for 4 mo., at 9%;
$\$959.10 - \$824 = \$135.10$, net gain;
$\$135.10 \div \$800 = .16\frac{7}{8}\frac{1}{0} = 16\frac{7}{8}\frac{1}{0}\%$.

80. 8 mo. 24 da. $\therefore$.044 (at 6%);
$\$.95 \times 2560 = \$2432$, cost of wheat;
$\$2432 \times .044 \times \frac{4}{3} = \$142.677\frac{1}{3}$, int. at 8%;
$\$2432 + \$142.677\frac{1}{3} = \$2574.677\frac{1}{3}$, total cost;
$\$1.15 \times 2560 = \$2944$, sale receipts;
$\$2944 - \$2574.677\frac{1}{3} = \$369.322\frac{2}{3}$, gain.

81. $\$3240 \times \frac{2}{3} = \$2160$, amount insured;
$\$2160 \times .00\frac{3}{4} = \$16.20$, premium.

82. $\$19.20 \div .015 = \$1280$, amount insured;
$\$1280 \div \frac{5}{8} = \$2048$, value of house.

83. $\$25000 \div 1.025 = \$24390.2439+$, proceeds invested;
$\$24390.2439 \div \$.05 = 487804.878+$, no. of pounds.
(2) $\$25000 - \$24390.2439+ = \$609.756+$, com.

84. $\$502.50 \div 1.005 = \$500$, amount invested;
$\$500 \div \$1.25 = 400$, number of yards bought.

85. 7 mo. 10 da. $\therefore$.036$\frac{2}{3}$ (at 6%);
$\$125.50 \times .036\frac{2}{3} \times \frac{7}{8} = \$5.3686+$, interest.

86. 2 mo. 2 da. $\therefore$.010$\frac{1}{3}$ (at 6%);
$\$50000 \times .010\frac{1}{3} \times \frac{4}{5} = \$688.888\frac{8}{9}$, interest.

87. 1 yr. 1 mo. 24 da. $\therefore$.069; $7\frac{1}{2}\% = \frac{5}{4}$ of 6%;
$\$75.50 \times .069 \times \frac{5}{4} = \$6.5111875$, interest.

88. 2 yr. 6 mo. $\therefore$.15;
$\$800 \times .15 \div 6 = \$20$, interest at 1%;
$\$90 \div \$20 = 4\frac{1}{2}$, rate.

89. $\$337.40 - \$311.50 = \$25.90$, interest;
$\$311.50 \times .08 \div 6 = \$4.15\frac{1}{3}$, int. at 1% for 1 yr. 4 mo.;
$\$25.90 \div \$4.15\frac{1}{3} = 6\frac{2}{4}\frac{1}{3}$, rate.

90. $\$.045 \times 3 = \$.135$, interest of \$1 for 3 yr., at $4\frac{1}{2}\%$;
$\$540 \times .10 \times \frac{7}{6} = \$63$, int. for 1 yr. 8 mo., at 7%;
$\$63 \div \$.135 = 466\frac{2}{3}$; $\$1 \times 466\frac{2}{3} = \$466\frac{2}{3}$.
Or, $\$63 \div .135 = \$466\frac{2}{3}$, sum of money required.

91. $\$750 \div \frac{5}{4} = \$600$, principal;
$\$750 - \$600 = \$150$, interest for 3 years;
$\$150 \div 3 = \$50$, interest for 1 year;
$\$50 \div \$600 = .08\frac{1}{3} = 8\frac{1}{3}\%$, rate per cent.

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92.

1883	11	4	
1882	10	8	
1 yr.	0 mo.	26 da.	

$\$30. \quad .064\frac{1}{3}.$

1884	1	30	
1883	11	4	
2 mo.		26 da.	

$\$250. \quad .014\frac{1}{3}.$

1884	7	1	
1884	1	30	
5 mo.		1 da.	

$.025\frac{1}{6}.$

$500.	
$.064\frac{1}{3}$	
$2)\$32.166\frac{2}{3}$	
$16.083\frac{1}{3}$	
$\$48.25,$	1st interest.
500	
$.014\frac{1}{3}$	
$2)\$7.166\frac{2}{3}$	
$3.583\frac{1}{3}$	
$\$10.75,$	2d interest.
$48.25,$	1st interest.
$\$500.$	
$\$559.$	

$\$250 + \$30 = 280$, 1st and 2d pay't.
$\$279$ [next page]

$279
.025$\frac{1}{6}$
2)$7.0215
3.5107
$10.5322, 3d interest.
279.
$289.532, amount due.

93. 90 da. + 3 da. = 93 da. ∴ .0155;
$125 × .0155 × $\frac{4}{3}$ = 2.583\frac{1}{3}$, discount.
(2) $125 — 2.583\frac{1}{3}$ = 122.416\frac{2}{3}$, proceeds.

94. 93 da. ∴ .0155;
$359.50 × .0155 × $\frac{4}{3}$ = 7.429\frac{2}{3}$, discount;

95. 4 mo. 3 da. = .0205; .0205 × $\frac{10}{6}$ = .034$\frac{1}{6}$;
$1.00 — $.034$\frac{1}{6}$ = $.965$\frac{5}{6}$, proceeds of $1, at 10%;
$300 ÷ .965$\frac{5}{6}$ = $310.612+, face of note.

96. 3 yr. 4 mo. ∴ .20;
$1.00 + $.20 = $1.20, amt. of $1;
$1320 ÷ 1.20 = $1100, present worth;
$1320 — $1100 = $220, discount.

97. $10.80 : $89.28 :: $75 : *Ans.* = $620.
Or, $10.80 ÷ 75 = $.144, sum yielded by $1;
$89.28 ÷ $.144 = 620, no. of dollars to yield $89.28.

98. $475 : $850 :: $118.75 : *Ans.* = $212.50.
Or, $118.75 ÷ 475 = $.25, interest of $1;
$.25 × 850 = $212.50, interest of $850.

99. 12% ÷ 5% = 2$\frac{2}{5}$; $120.50 × 2$\frac{2}{5}$ = $289.20.
Or, $120.50 ÷ 5 = $24.10, interest at 1%;
$24.10 × 12 = $289.20, interest at 10%.

100. $4.90 × 250 = $1225, cost of bill.

101. 5.16$\frac{1}{2}$ fr. × 2400 = 12396 fr., face of bill.

102. $.96$\frac{3}{4}$ × 19350 ÷ 4 = 4680.281\frac{1}{4}$, cost of bill.

103. $150 × 6 = $900, use for 1 month;
$900 ÷ $100 = 9, number of months.

104. $ 50 × 2 = $ 100
$100 × 5 = $ 500
$150 × 8 = $1200
$300)$1800(6, number of months.

The equated time is 6 months after date.

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105. $ 300 × 5 = $1500
$ 700 × 3 = $2100
$ 200 × 8 = $1600
2)$1200 $5200
$ 600 × 2 = $1200
$ 600)$4000($6\frac{2}{3}$, number of months.

The equated time for the payment of the other half is $6\frac{2}{3}$ months after date.

Or, $5200 ÷ $1200 = $4\frac{1}{3}$, time for payment of whole;
$4\frac{1}{3}$ mos. − 2 mos. = $2\frac{1}{3}$ mos., $\frac{1}{2}$ paid before due.
$4\frac{1}{3}$ mos. + $2\frac{1}{3}$ mos. = $6\frac{2}{3}$ mos., time of payment of other $\frac{1}{2}$.

Since one half is paid $2\frac{1}{3}$ months before maturity, the other half may be kept $2\frac{1}{3}$ months after maturity.

106. 50 bu. × 1.20 = 60 bu.;
60 bu. ÷ 120 bu. = $\frac{1}{2}$;
$150 × $\frac{1}{2}$ = $75, A's share;
$150 × $\frac{1}{2}$ = $75, B's share.

Since a bushel of A's wheat is worth 20% more than a bushel of B's, A's 50 bushels equal in value B's 60 bushels, and hence each should receive $\frac{1}{2}$ of the $150, or $75.

Or, 120 bu.: 60 bu.:: $150: A's share = $75.
120 bu.: 60 bu.:: $150: B's share = $75.

107. $5\frac{1}{2} + 8 = 13\frac{1}{2}$, number of cords;
$27 ÷ $13\frac{1}{2}$ = $2, cost per cord;
$ 2 × $5\frac{1}{2}$ = $11, amount to be paid by first;
$ 2 × 8 = $16, amount to be paid by second.

Or, $13\frac{1}{2}$ cd. : $5\frac{1}{2}$ cd. :: \$27 : first's share = \$11.
$13\frac{1}{2}$ cd. : 8 cd. :: \$27 : second's share = \$16.

108. 84 cd. ÷ 12 ÷ 7 ÷ 8 = $\frac{1}{8}$ cd., what 1 man cut in 1 hr;
$\frac{1}{8}$ cd. × 10 × 5 = $6\frac{1}{4}$ cd., what 1 man can cut in time;
150 cd. ÷ $6\frac{1}{4}$ cd. = 24, number of men.

Or, $\left.\begin{matrix}84\text{ cd.}:150\text{ cd.}\\10\text{ da.}:12\text{ da.}\\5\text{ h.}:7\text{ h.}\end{matrix}\right\}$:: 8 men : *Ans.* = 24 men.

109. 84 bu. ÷ 16 ÷ 24 = $\frac{7}{8\frac{1}{2}}$ bu., what 1 horse eats in 1 day;
$\frac{7}{8\frac{1}{2}}$ bu. × 36 × 16 = 126 bu., amount required.

Or, $\left.\begin{matrix}16\text{ horses}:36\text{ horses}\\24\text{ days}:16\text{ days}\end{matrix}\right\}$:: 84 bu. : *Ans.* = 126 bu.

110. $\left.\begin{matrix}24\text{ men}:36\text{ men}\\4\text{ days}:3\text{ days}\end{matrix}\right\}$:: \$192 : *Ans.* = \$216.

111. $\left.\begin{matrix}4\text{ men}:7\text{ men}\\7\frac{2}{3}\text{ da.}:30\frac{2}{3}\text{ da.}\end{matrix}\right\}$:: $\$53\frac{1}{3}$: *Ans.* = $\$375\frac{2}{3}$.

112. \$ 750 − \$600 = \$150, A's gain;
\$ 600 ÷ \$150 = 4, ratio of B's to A's stock;
\$1200 × 4 = \$4800, B's stock.

Since B's gain (\$600) was 4 times A's gain (\$150), B's stock was 4 times A's stock, or 4 times \$1200, which is \$4800.

Or, \$150 : \$600 :: \$1200 : B's stock = \$4800.

113. \$2000 × 12 = \$24000, A's stock for 1 month;
\$800 × 12 = \$9600, B's stock for 1 month;
\$24000 − \$9600 = \$14400, excess of A's for 1 mo.;
\$14400 ÷ 6 = \$2400, B's added stock for 6 months.

Since A's stock for 1 month is \$14400 more than B's original stock for 1 month, at the close of 6 months B must put in $\frac{1}{6}$ of \$14400, or \$2400.

114. \$ 200 × 5 = \$1000, A's capital for 1 mo.;
\$ 300 × 2 = \$ 600, B's capital for 1 mo.;
\$1000 + \$ 600 = \$1600, total capital for 1 mo.;
\$ 200 + \$ 300 = \$ 500, total capital;
\$1389 − \$ 500 = \$ 889, whole gain;
\$1000 ÷ \$1600 = $\frac{5}{8}$, A's part of gain;
\$ 600 ÷ \$1600 = $\frac{3}{8}$, B's part of gain;

$\$889 \times \frac{5}{8} = \$555\frac{5}{8}$, A's gain;
$\$889 \times \frac{3}{8} = \$333\frac{3}{8}$, B's gain;
Or, \$1600 : \$1000 :: \$889 : A's gain = $\$555\frac{5}{8}$
\$1600 : \$ 600 :: \$889 : B's gain = $\$333\frac{3}{8}$.

115. (1) $\sqrt{41616} = 204$. (2) $\sqrt{420.25} = 20.5$.

116. (1) $\sqrt[3]{46656} = 36$. (2) $\sqrt[3]{42.875} = 3.5$.

117. $\sqrt{50^2 - 30^2} = \sqrt{1600} = 40$, no. of feet.

NOTE.—The ladder is the *hypotenuse* of a right-angled triangle, the height of the window being the *altitude*, and the distance of the foot of the ladder from the base of the building, the *base*.

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118. $\sqrt{52^2 + 39^2} = \sqrt{4225} = 65$, miles.

119. $\sqrt{40^2 + 30^2} = \sqrt{2500} = 50$, feet.

120. 10 acres = 160 sq. rd. $\times$ 10 = 1600 sq. rd.;
$\sqrt{1600} = 40$, rods in each side of square;
40 rd. $\times$ 4 = 160 rods, perimeter of square.

121. $\sqrt{24^2 + 15^2} = \sqrt{801} = 28.3+$, number of feet.

122. $\sqrt{20^2 + 16^2} = \sqrt{656} = 25.61+$, ft. in floor diag.
$\sqrt{(25.61+)^2 + 12^2} = \sqrt{800} = 28.28+$, feet in diagonal from lower corner to upper opposite corner.

NOTE.—The teacher can make the process plain by taking the school-room as an illustration. If the lower corner be called A, the opposite lower corner B, and the opposite upper corner C, the diagonal A B is 25.61 + feet, being the hypotenuse of a right-angled triangle whose sides are 20 ft. and 16 ft.; and the diagonal A C is 28.28 + feet, being the hypotenuse of a right-angled triangle whose sides are 25.61 + ft. and 12 ft. Since $\sqrt{656} = 25.61+$, $(25.61+)^2 = 656.$, and hence $(25.61+)^2 + 14^2 = 800$.

123. 8 cu. ft. $\times 5\frac{1}{2} \times 3\frac{1}{2} = 154$ cu. ft.

124. 6 sq. ft. $\times$ 4 = 24 sq. ft., in top or bottom;
24 sq. ft. $\times$ 2 = 48 sq. ft., in top and bottom;
6 sq. ft. $\times 1\frac{1}{2} \times 2 = 18$ sq. ft., in 2 sides;

4 sq. ft. $\times 1\frac{1}{2} \times 2 = 12$ sq. ft., in 2 ends;
48 sq. ft. + 18 sq. ft. + 12 sq. ft. = 78 sq. ft., in whole surface.

125. 40 rd. $\times$ 3.1416 = 125.664 rd., circumference.
(2) 125.664 sq. rd. $\times \frac{40}{4} = 1256.64$ sq. rd., in field;
1256.64 sq. rd. $\div$ 160 sq. rd. = 7.854, no. of acres.

126. 470.875 $\div$.7854 = 599.5352 +, square of diameter.
$\sqrt{599.5352+} = 24.48+$, inches in diameter.

127. $2^3 : 8^3 :: 1 :$ Ans. $= 64$, number of 2-inch balls.
Or, $2 : 8 :: 1 : 4$; $1^3 : 4^3 :: 1 :$ Ans. $= 64$.

128. 8 cu. ft. $\times 4 \times 2 = 64$ cu. ft., in block of wood;
$\frac{1}{3}$ cu. ft. $\times \frac{1}{3} \times \frac{1}{3} = \frac{1}{27}$ cu. ft., in small block;
64 cu. ft. $\div \frac{1}{27}$ cu. ft. $= 1728$, no. of small blocks.

NOTE.—A block $\frac{1}{3}$ ft. long, 1 ft. wide and 1 ft. thick contains $\frac{1}{3}$ cu. ft., and hence a block $\frac{1}{3}$ ft. long, $\frac{1}{3}$ ft. wide, and $\frac{1}{3}$ ft. thick contains $\frac{1}{3}$ cu. ft. $\times \frac{1}{3} \times \frac{1}{3}$, which is $\frac{1}{27}$ cu. ft.

129. 12 cu. in. $\times$ 10 $\times$ 8 = 960 cu. in., in box;
2 cu. in. $\times$ 2 $\times$ 2 = 8 cu. in., in block;
960 cu. in. $\div$ 8 cu. in. = 120, number of blocks.
Or, 12 in. $\div$ 2 in. = 6: 10 in. $\div$ 2 in. = 5;
8 in. $\div$ 2 in. = 4;
6 blocks $\times$ 5 $\times$ 4 = 120 blocks.

NOTE.—The first solution is possible only when the dimensions of the box are respectively *multiples* of the edges of the cubical block. In the second solution, the number of blocks that equal the length of the box, is taken as the multiplicand. This multiplied by 5 gives the number of blocks that can be put in the box 1 block deep, and this product multiplied by 4 gives the whole number of blocks that can be put in the box.

130. 12 cu. in. $\times$ 10 $\times$ 6 = 720 cu. in., in box;
4 cu. in. $\times 2\frac{1}{2} \times 1\frac{1}{5} = 12$ cu. in., in bar of soap;
720 cu. in. $\div$ 12 cu. in. = 60, number of bars.
Or, 12 in. $\div$ 4 in. = 3; 10 in. $\div 2\frac{1}{2}$ in. = 4;
6 in. $\div 1\frac{1}{5}$ in. = 5; 3 bars $\times 4 \times 5 = 60$ bars.

NOTE.—Since the length, width, and depth of the box are respectively *multiples* of the length, width, and thickness of a bar of soap, the first solution is correct.

131. 1728 cu. in. $\times$ (8 $\times$ 5 $\times$ 4) = 276480 cu. in., in bin;
276480 cu. in. $\div$ 2150.4 cu. in. = 128.57 +, no. bu.

132. $6^2 \times .7854 = 28.2744$, number sq. ft. in base;
28.2744 cu. ft. $\times$ 7 = 197.9208 cu. ft., in cistern;
1728 cu. in. $\times$ 197.9208 = 342007.1424 cu. in.;
342007.1424 cu. in. $\div$ 231 cu. in. = 1480.55+, no. gal.
(2) 1480.55 gal. $\div$ 31.5 gal. = $47.0\frac{1}{63}$, no. barrels.

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133. $6^2 \times .7854 = 28.2744$, no. of sq. ft. in base;
28.2744 cu. ft. $\times$ 9 = 254.4696 cu. ft. in cistern;
1728 cu. in. $\times$ 254.4696 = 439723.4688 cu. in.;
439723.4688 cu. in. $\div$ 231 cu. in. = 1903.5648, no. gal.;
1903.5648 gal. $\div$ 31.5 gal. = 60.43 +, no. of bbl.

134. 7 cu. ft. $\times$ 6 $\times$ $5\frac{1}{2}$ = 231 cu. ft., in tank;
1728 cu. in. $\times$ 231 $\div$ 231 cu. in. = 1728, no. of gal.
1728 gal. $\div$ 31.5 gal. = $54\frac{4}{7}$, number of barrels.

135. $4^2 \times .7854 \times 6 = 75.3984$, no. of cu. ft. in cistern;
1728 cu. in. $\times$ 75.3984 = 130288.4352 cu. in.;
130288.4352 cu. in. $\div$ 231 cu. in. = 564.019 +, no. gal.

136. 36.1 sq. in. $\times$ 5 $\div$ 2 = 90.25 sq. in., area of triangle.
$\sqrt{90.25} = 9.5$, no. of in. in side of equiv. square.

137. 110 ft. $\div$ 3.1416 = 35.014 + ft., diameter.

138. 94.248 ft. $\div$ 3.1416 = 30 ft., diameter;
30 sq. ft. $\times$ 30 $\times$.7854 = 706.86 sq. ft., area av. sec.;
706.86 cu. ft. $\times$ 100 = 70686 cu. ft., solid contents.

139. 91400000 mi. $\times$ 2 = 182800000 mi., diam. of orbit.;
182800000 mi. $\times$ 3.1416 = 574284480 mi., cir. orbit;
24 hours $\times$ $365\frac{1}{4}$ = 8766 hours, in one revolution;
574284480 $\div$ 8766 = 65512.7+, no. of mi. per hour.

140. 35400000 mi. $\times$ 2 = 70800000 mi., diam. of orbit;
70800000 mi. $\times$ 3.1416 = 222425280 mi., cir. orbit;
24 hours $\times$ 87.9 = 21092 hours, in one revolution;
222425280 $\div$ 21092 = 105434.8 +, miles per hour.

141. 2 ft. 8 in. = 32 in.; 32 in. $\times$ 5 = 160 in.;
1 ft. 10 in. = 22 in.; 22 in $\times$ 8 = 176 in.;
176 in. $\div$ 160 in. = 1.1, ratio between rates:
$3\frac{3}{4}$ mi. $\times$ 1.1 = 4.125 mi $= 4\frac{1}{8}$ mi.

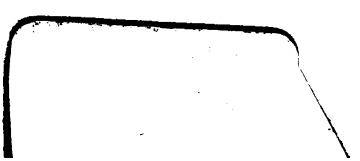
Since the boy walks 176 inches while the man walks 160 inches, the boy walks 1.1 times the distance walked by the man. $3\frac{3}{4} \times 1.1 = 3.75 \times 1.1$

142. 4 : 8 :: 40 ft. height of 1st tree = 80 ft.;
4 : 5 :: 40 ft. height of 2d tree = 50 ft.;
80 ft. $-$ 50 ft. = 30 ft., diff. in heights of trees;
$\sqrt{40^2 + 30^2} = \sqrt{2500} = 50$, no. of ft. between tops.

NOTE.—A line drawn horizontally from the top of the second tree to the first tree will reach it 30 feet below its top; and a line joining the tops of the trees will be the hypotenuse of a right-triangle of which 40 feet, the width of the stream, is the *base*, and 30 feet, the difference in heights of trees, the *perpendicular*.

143. $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$, part flowing in in 1 hour;
$\frac{1}{5} + \frac{1}{6} + \frac{1}{7\frac{1}{2}} = \frac{1}{2}$, part flowing out in 1 hour;
$\frac{5}{6} - \frac{1}{2} = \frac{1}{3}$, part of cistern filled each hour;
$1 \div \frac{1}{3} = 3$, no. of hours in which it will be filled.

A quantity of liquid equal to $\frac{5}{6}$ the capacity of the cistern flows in each hour, while a quantity equal to $\frac{1}{2}$ of its capacity flows out each hour; and hence the quantity in the cistern increases each hour by their difference ($\frac{1}{3}$ the capacity of the cistern), and this will fill the cistern in 3 hours.



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